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The Milling Machine—Its Construction and Uses.

By JOHN J. GRANT.

FOURTEENTH PAPER.

It is often necessary to cut into the end of a round piece, one or more slots, as in the arbor for cutting face-mills described in a former article. Where the piece is too large to pass through the chuck, or where a large number are to be milled, a simple and very accurate little device is the one shown in Fig. 12. It can be made any shape—either square, hexagonal, or octagonal—and of any size within the capacity of the vise belonging to the machine. The various uses to which this little fixture may be put can hardly be enumerated, but will suggest themselves to the operator. In fact, it takes the place of the elevating head in a great many operations, and is more rigid. The cut shows the construction of it, and Fig. 13 some of the uses that can be made with it. It should be made with as large opening as possible, and fitted with various sizes of bushings that are split open in the same manner as the fixture itself.

Another handy fixture is an angle iron, made adjustable. This is as essential to the complete equipment of the universal milling machine as the vise or centers. I have often made drawings for an angle-iron like the cut, Fig. 1. It could be made to depress at 45° angle, and be graduated on one arc to degree marks, and on the other to fractions of an inch per foot. It would be as useful for the plain milling machine and planer as for the universal machine. The face should have T-slots running through, to which could be attached parallel strips and clamps. Rows of holes should be drilled in the center, between the slots, for the purpose of using screw dogs. Pins turned to exact size and inserted in these holes, would make a good stop or rest for pieces being milled. This kind of fixture would be especially valuable in milling the edges of bevel gibs. The work could be clamped to it, and the angle-iron thrown back to the required angle, and a straight slabbing cutter used for the work. A cheap substitute for this fixture could be made by fitting a plate about 12″ long by 6″ wide to the spindle of the elevating head; when the head is on crosswise of the platen, the same cuts could be taken with the angle-iron; but, of course, it is not as solid.

Used in connection with the angle-iron shown, the tool made as in Fig. 2 will be found very convenient and accurate. It is designed for milling any tapering pieces, such as keys for cranks, gears, couplings, pulleys, and similar work. The taper per foot, in inches, can be milled perfectly. The construction will be readily understood with the following explanations: The piece marked *A* is made, preferably, of steel. In the smaller size it should be 6″ long from the pin *B* to the outer end; in width about ½″ less than the height of the vise jaws, and about ⅝″ thick. Mill through the entire length a slot about ⅜″ wide and one-half the depth of the piece, or to the dotted line *C*. Mill a piece to fit into this, and put in a joint at *B*. *D* is an adjusting screw ½″ diameter, and short enough when down to the bottom to be below the dotted line *C*. It should be put in before the slot is milled out, as there will be enough thread left on each side to hold the screw when it is above the line *C*, thus allowing a greater range of adjustment. If the center of the joint is exactly 6″ from the outer end it will be very easy to graduate it at *E* to fractions of an inch per foot taper. This fixture or tool is also equally valuable for either planer, plain or universal milling machine. For work that has been splined with an angle-iron such as described in Fig. 1, if keys were milled with the adjustable wedge block, a perfect fit would be insured without any hand fitting.

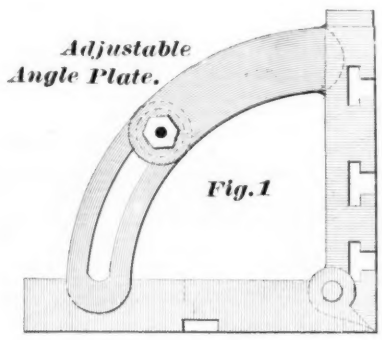
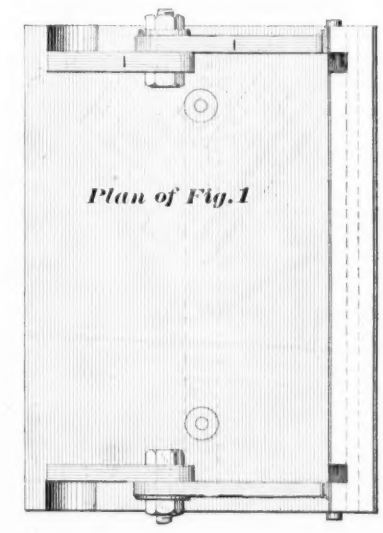


Fig. 1


Plan of Fig. 1

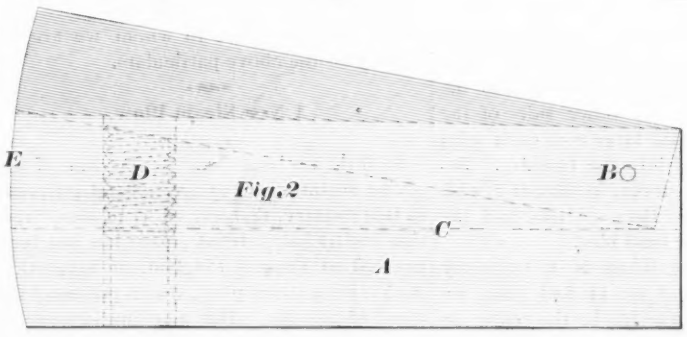


Fig. 2

Plan

In making forming tools, the universal milling machine can be used to great advantage. As these tools are coming into more general use for the lathe, planer, and screw machine, it is well to know the best methods of making them. If there are many tools to make of a perfect circle, taper mills, cut spiral and fitted into the spindle of the machine, are the best. This form will give a perfect clearance all the way around the half circle necessary for the tool. The tool should be held rigidly in the vise, with the jaws parallel with the platen. If the shape is irregular, the form should be traced on the face side, and, by using shank cutters of different diameters, they can be worked out so that very little hand work is necessary. In cases where large numbers of forming tools are wanted of one shape, it is better to make a cutter of the form to be produced by the forming tool. Where the forming tool is difficult to shape, and the number wanted will not justify the making of an expensive cutter, a simple tool and holder can be made like the cuts, Figs. 14 and 15; it is called a "fly" cutter, and in experimental work, where the possibilities are that only one piece may be made, this little tool is very convenient, and will do very fair work. It is used extensively on brass work, in clock factories, for cutting gears, &c. This cutter needs but little explanation, as the cut shows the construction perfectly. The cutter may be either filed to shape, or formed by a tool held in the vise, having a shape the opposite to that wanted. In this case it is necessary to form a clearance on the tool, or, if not necessary, it is certainly better, as it can then be ground, keeping the shape the same until worn entirely away. This can be accomplished by moving the cutter towards *A* (see end view, Fig. 15). The face of the cutter should always be on a line with the center of the arbor, thus insuring a perfect reproduction of the shape of the tool.

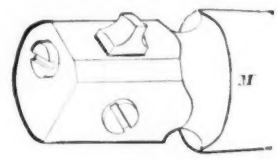


Fig. 14

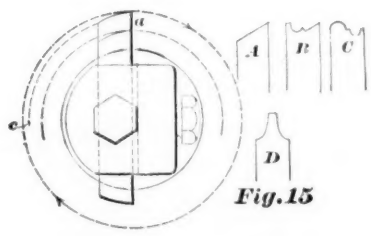


Fig. 15

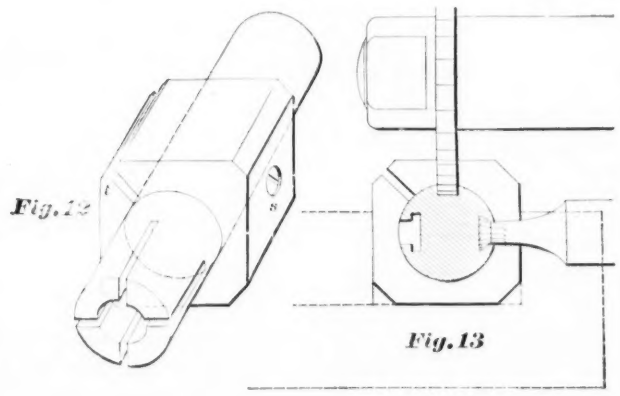
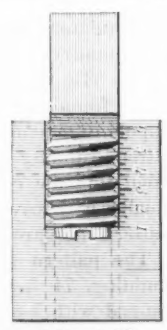


Fig. 13


Adjustable
Wedge Block

In making thin cutters for slotting screws and for work that does not require the cutter to penetrate to a great depth, they can be punched from sheet steel of the required gauge, of a diameter about 2½″. The hole should be ¾″ diameter. This may be punched a trifle smaller—enough to ream to size. The arbor for turning them should be made about 6″ long, and with collars 2′ diameter. This will hold from 40 to 80, according to the gauge. Of course, in turning them, no particular size is necessary. The same arbor is used for cutting the teeth. In a slotting cutter of this size there should be about 60 teeth, cut to a sharp edge. No further labor is needed before hardening. Draw the temper a little lower than a common milling cutter—that is, so that a file will take hold readily. As a general thing, the cutters will be found to be sprung after hardening. No attention need be paid to this, as the arbor used for carrying slotting cutters of this size should have collars at least 1¾″ diameter, and if for slotting screws only, they may be 2″ diameter. When tightened between collars of this size, the cutter will be drawn practically straight. When cutters as thin as the above are wanted for cutting deep slots, or for splitting open work, and it is necessary for them to run true, the only way to accomplish this is to make them enough thicker, and grind them after being hardened. In my next I will show a fixture for doing this kind of work that operates first-class.

Too much cannot be said in the matter of keeping the milling cutters sharp and in perfect order; also look well to the machine itself; have all the gibs kept up to a good bearing, both on the elevating knee and the cross slide. The spindle should never be allowed to run loose, as it is impossible to obtain good results in milling without everything being kept snug and tight.

Director-General Burke, of the Southern World's Exposition, speaking of the purposes of the exhibition, said: "One of the chief features of the exposition will be a world's exhibition of woman's work, organized by women, conducted by women, with the whole field of labor opened to their pre-emption, and the growing youth of this country who is felicitating himself upon occupying the soft places had better learn the use of the jack-plane, or how to hold the plow. The American girl is coming and the man milliner must go."

The London *Economist* takes a gloomy view of English industries, pointing out that the number employed in industrial pursuits is materially decreasing, while the number of physicians, lawyers, musicians, and actors is rapidly increasing.

New York, West Shore & Buffalo Ry. Co. Shops at Frankfort, N. Y.

These shops are arranged on the radial system; that is, they are all grouped radially around a 60 ft. turntable in the center. This system was proposed by the late Howard Fry, and has many advantages over other arrangements of shops inasmuch as it allows for unlimited extension without decreasing the facilities for handling the material.

Close to the turntable, and between it and the main tracks, the storehouse is located, which brings this building in a central position, and nearly equi-distant from all shops to be supplied.

The faces of the various buildings are arranged at a radius of 150 feet from the center of the table.

On the east side of the table is placed the blacksmith shop. This building is at present 192 feet long by 74 feet wide. It is, however, to be extended to double this length in the near future.

Next to this, at an angle of 32 deg., comes the boiler shop. Opposite the boiler shop, on the same side of the table, is the foundry, with brass foundry, cupola room, core ovens, core rooms, and pattern shop at the back. In the angle formed by these buildings the pattern storehouse is placed. Opposite the blacksmith shop, and on the same center line, the main erecting and machine shop is placed. This building will also be extended.

The paint shop is placed some distance away from the other shops, so as to be out of the way of dust and dirt.

On the opposite side of the main track the round house is placed, so as to be handy to the freight yard, which is on the opposite side of the main track from the shops.

These shops are all connected together by a system of standard and narrow-gauge tracks and turntables. The narrow-gauge tracks are 18."

The blacksmith shop, as at present arranged, will contain 36 forges, 3 steam hammers, bolt headers, and the necessary punches and shears. This shop is only intended to do the general run of locomotive blacksmith work. All heavy work will be done in the hammer shop, to be erected in the spring. This shop will contain large steam hammers and necessary furnaces for this work.

The boiler shop is arranged with two riveting towers, one each side, as shown. At the back end of the shop, furthest from the table, all the machinery is placed. The front end of the shop nearest the table is used for erecting purposes. The whole length of the shops is commanded by two overhead power traveling cranes 60 ft. span, 15 tons capacity each. There is also an overhead power traveling crane in each riveting tower of ten tons capacity each, to command the riveters. The erecting part of this shop is to be extended to the same radius line as the face of the blacksmith shop.

The main body of the foundry is arranged with a center roof 30 ft. span, and two wing roofs 20 feet span each. There are two traveling cranes 30 feet span, and ten tons capacity each, running the whole length of the center portion of building.

Back of the foundry is placed the cupola room, containing two Colliau cupolas. These are commanded by the overhead traveling cranes, also by a system of 18" gauge tracks carrying metal bogies to supply the portions of the foundry in which the light work is done. On one side of the cupola room the engine room is placed, containing two No. 6 Baker blowers to furnish the blast for the cupolas and the engine for driving the overhead traveling cranes and moulding machines in the foundry. The hydraulic pumps and accumulators for working the stock hoist and foundry cranes are also placed in this room. To the south of this is placed the brass foundry. On the other side of the cupola room comes the large core oven with a track running out into the foundry. Beyond this the core room, connecting with smaller core ovens. Between this and the pattern shop are the sand bins.

The pattern store house is a two-story building, 74 ft. long by 44 feet wide, arranged with hydraulic lift in the center, to command the second floor.

The main erecting and machine shop is arranged with center span 50 ft., and a wing roof each side 30 ft. span. There are two overhead power traveling cranes 50 ft. span, 30 tons capacity each, running the whole length of this building in the center span, commanding erecting tracks each side of center track. The machines are arranged along either side of erecting shop proper. The heavy machinery for doing cylinder and frame work is placed on the north side, and the light machinery on the south side. On the north side, between the lines of heavy tools, runs a standard gauge track with two walking jib cranes driven by rope. These cranes command the various tools, and transfer the work from one to another,

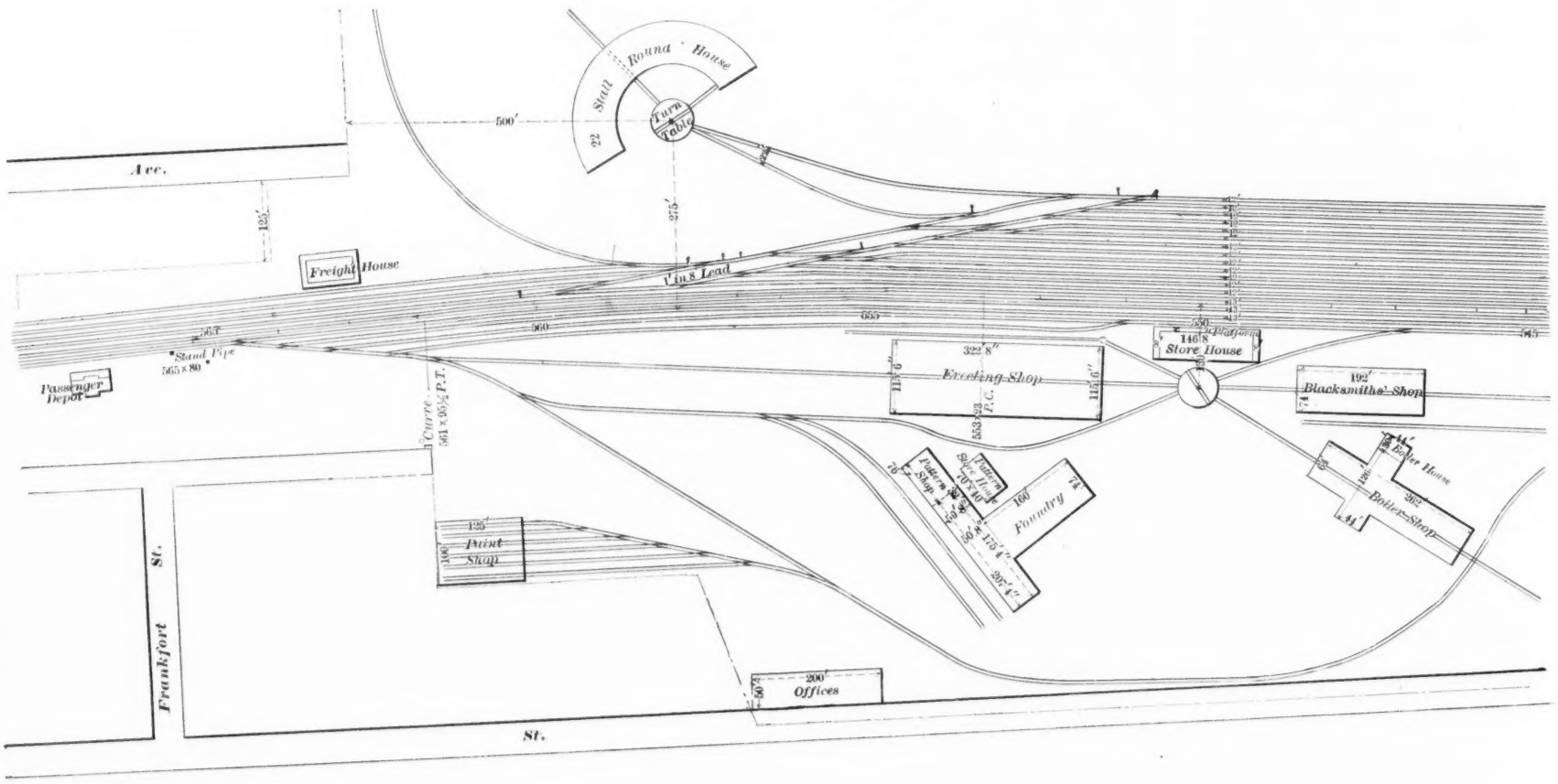
The idea in arranging these shops on the radial system was that raw material could be supplied to the shops at the ends remotest from the turntable, and the machinery has been so arranged in the shops that the work passes from one machine to another until it reaches the end nearest the turntable in a finished condition, ready to be transferred to the erecting shop. On the south side of the erecting shop, and attached to it, there is another wing 30 ft. span, not shown on the plan, containing tool-room and grinding room.

The paint shop is a one story building, arranged to take two locomotives and tenders on each track.

The office building, which is located on the main street, is two stories high. Ground floor contains the offices of Supt. M. P., Chief Clerk M. P., Master Mechanic of the shops, and various clerks' offices. The top floor contains the office of Mechanical Engineer, drawing office, model room and blue print rooms connected therewith.

The planing mill and freight car repair shops are located about ½ mile further to the east of the locomotive shops.

The work of scheming out the designs of these shops was done by Mr. John Player, Mechanical Engineer, to whom we are indebted for the above particulars.



SHOPS AND YARDS OF THE WEST SHORE RAILROAD AT FRANKFORT, N. Y.

A New Steam Plow.

So little has been done in the way of applying steam power to agricultural purposes in this country, that any effort in that direction excites interest. A patent has just been granted to Francis Pidgeon, of Saugerties, N. Y., for a steam plow, which possesses the merit of novelty. The machine consists of an oblong frame which carries a gang of plows on each end. When one end is at work the other end is raised in the air, proper mechanism being provided to make the change. The frame is conveyed on a double-wheeled carriage, on which is also the boiler for supplying steam, and the machinery for applying the power. The wheels are large with broad rims, so that they will not sink into the ground they traverse.

In some parts of Europe steam plowing is a regular feature of farming operations, and that method of cultivating the soil is found economical. But in every case the engine and boiler working the plow is left at the end of the field, and the transmission of power is done by wire ropes. By this means nearly the whole of the power applied is expended upon pulling the implement which is cutting up the furrows. In some respects the American invention may be a simpler machine than that which does its work by winding a complication of wire ropes, but the chances are that it would take more power to move the engine through a soft field than it would take to operate the plow; and an unusually soft spot would leave no power for the cultivators. Agriculture is a promising field for mechanical invention, but we are afraid that this new steam plow is not going to fill "the long felt want."

Boiler Explosions in Great Britain.

The British Parliament, in trying to reduce the disasters of boiler explosions, passed an act a little over a year ago, which was expected in a great measure to prevent these accidents. The provisions of the act were directed mostly to the systematic examination of boiler attendants, and to the regular inspection of boilers. Its working does not seem to have improved matters very much. During the year after the act went into operation, thirty-five persons were killed and thirty-three injured by boiler explosions. Just as in this country, the prevailing causes of explosions in Great Britain are the unsafe condition of the boilers through corrosion and old age. And there the same reason for complaint exists, that it is almost impossible to make owners of worn-out boilers understand the risks they are subjecting life and property to by delaying to have their boilers renewed or properly repaired.

Boiler Explosion at Pittsburgh.

A disastrous boiler explosion happened at the Empire Oil Works, Pittsburgh, last week, killing several persons. The fireman in charge of the boilers depended on the appearance of the water-gauge without trying it, and did not seem to know whether there was water in the boiler or not. His impression was in the direction that the water must have been low, for when the explosion happened he was trying to start the pump. He had only been a short time at the business. The boiler inspector had not examined the boiler for three years. Pittsburgh people are wondering how many more boilers there are around ready to go in the air without warning. As usual, the boiler inspector is getting the principal part of the abuse about the boiler exploding, but we think the owner of the boiler is really the responsible party, if the disaster is due to neglect.

Safe and Unsafe Methods of Boiler Making.

BY GEORGE MARSHALL.

In the manufacture of steam boilers the tensile strength of the plate is much weakened by the process of punching the holes, even with the most improved punch devised for that purpose.

How much more it can be weakened without breaking the holes from the body of the plate by the skilled foremen who insist on using a punch, made after their own design and in accordance with their own theory "that the point of the punch must be smaller than the shoulder," in order that it may draw easier from the plate, is a problem yet unsolved. Yet, strange as it may seem, this is done in a number of boiler shops throughout the country, and this theory is held by some otherwise intelligent foremen.

Boilers are built, tested, set in position and allowed to daily carry a pressure varying from forty to seventy-five pounds to the square inch, which in reality should be consigned to the scrap heap or sold to the mill for old iron.

Many boilers in use to-day, some of them known to the writer, are unfit for service by reason of their age, corroded and crystallized condition; yet their owners, knowing their weakness, cling to them and their dollars rather than buy new ones, until some time in the near future we will read in the morning or evening papers of "Another Boiler Explosion! No cause can be assigned for the Accident."

In reality there are no mysterious explosions. Sift the history of a boiler back to its maker, examine the method of his doing business, learn the skill and experience of the workmen employed on it, follow it to its destination and learn of its care from the purchaser, the character and ability of the man or boy employed to run it, the frequency or infrequency of its internal or external examination by competent or incompetent inspectors, the number of times it has had the man-hole plates taken out and undergone a thorough cleaning, the number of times the braces have been examined to ascertain their condition; if you do this you will find the solution of the mystery.

I have seen new boilers run out of a shop, painted and in some respects looking attractive, yet I knew they were actually dangerous and unfit to be used, from the fact that the inner sheet was so badly channelled by the excessive use of a caulking tool in the hands of an inexperienced caulker as to make an open fracture of the plate but a question of time and a brief time at that.

Some years ago the boiler of a steamboat plying on the Hudson exploded, killing one or two persons and scalding quite a number. The writer, with others, was directed by the coroner to make an examination of the boiler and be prepared to testify at the inquest. So far as I can now remember, the majority of the practical boilermakers who examined the boiler agreed in their conclusions that the boiler exploded, or blew out the side, from improper caulking, insufficient and imperfect bracing. The sheets forming the sides were put on with the grain of the iron running horizontally, and bent to a radius of about 4½ feet. The side sheet was placed outside of this, and in the process of caulking the sheet was channeled from one end to the other, the line of caulking being plainly visible on the inside of the sheet.

Neither the writer nor any of those holding his opinion were called on to testify when the inquest was held.

About a year previous to that time I was notified by parties in Mott Haven that their boiler was leaking very badly, and they wished me to make a personal examination before sending men to do the work. I found, on examination, the shell of the boiler in two separate pieces, held together by the flues (2-14″) and the channeling was in this case also so plain as to leave no doubt as to the cause of the fracture.

Ordinary individuals desiring to purchase a boiler will send to two or more builders, requesting an estimate and specification for the size boiler required. In many cases specifications are meant to deceive. A will put in an estimate basing his figures on the fact that he intends to use fire-box iron where fire-box iron is required; flange iron where that is required, and shell iron where that will answer as well as a higher priced grade. His specification is so worded, and he also says that the workmanship shall be in every respect first-class. B's specification gives the size of boiler the same as A, but says the iron used shall be the best Pennsylvania *C. H. Charcoal iron*, and the purchaser, not knowing the difference in the terms used, supposes that the quality of the material is the same, and awards the contract to the lowest bidder, while the difference in cost of material intended to be used by both parties would be greatly in favor of A and his work.

Second-hand flues are often used by unscrupulous builders, and the unsuspecting purchaser wonders why his flues are such a source of trouble after a year's run.

The honest builder works on close figures and reputation; the dishonest builder on close figures and stealing. Instances are frequent where refined iron has taken the place of fire box, and tank iron the place of flange, yet both may be of Pennsylvania manufacture, and neither of them the best.

Is it any wonder that so much difference exists in the estimates of builders? The unscrupulous man accumulates wealth and is considered smart and self-made; the honest builder toils on, making small profits, but adding to his reputation for honesty.

Riveting is another part that requires judicious manipulation, not so much in the method of driving as in the preparatory process. I am alluding to hand work. You can look into a shop where quantity, not quality, is the rule, and you behold two strong muscular individuals engaged in laying up the sheet. The hole is not fair, that is the two holes are not fairly in line one with the other, and the drift pin is taken up, put in the hole, and both belabor it until it has been driven in far enough to admit of the hot rivet being put in with ease. No thought is given to the danger incurred by this process; in fact they are not supposed to think anything about it; they are mere machines, and the standard of their value consists in the number of rivets they can drive in ten hours.

The scrupulous builder, by means of a center on his punch and a centered mark on the sheet, will take pains to see that the alignment of the holes is perfect; but should such a thing as a bad hole appear, the reamer is used instead of a drift, and the hole made true. Some shops use the drift altogether, and a reamer is almost an unknown tool, while in others the absence of the drift is particularly noticeable and the reamer is universally used in its stead.

Another Good Example.

Carnegie Brothers & Co., owners of the Union Iron Mills, Pittsburgh, Pa., have fitted up three rooms above their general offices in a comfortable shape as reading and recreation rooms for their workmen. The rooms are supplied with a variety of reading matter which embraces the leading newspapers and magazines, besides books of popular interest.

In the way of amusement, the means of playing chess, checkers, cribbage, etc., are provided. The management of the rooms has been vested in the men, and they have appointed a committee of management, who take sole charge. Although the rooms have been open but a short time, the attendance is most encouraging, and the indications are that the results will be beneficial. Many of the men are at liberty during the day, and to accommodate their hours of leisure the rooms are kept open from 9 A. M. to 10 P. M. We have no doubt but this experiment will develop into a mutual benefit association like what has come out of the Passaic Rolling Mills gift of a reading-room to their employes last season.

No Steel Ties for the Philadelphia and Reading Railroad.

A letter from Mr. Wootten, general manager of the Philadelphia and Reading Railroad, to this office says: There is no truth whatever in the report going the rounds of the newspapers, that this company is about trying experiments with metallic ties.

The statement is founded upon the fact that our chief engineer, Mr. Lorenz, while recently in Europe, collected a number of specimens of horse-car and steam-road rail intended to be supported upon steel ties. These specimens he has in his office, and they are very creditable attempts towards the solution of the question as to the practicability of the use of metallic cross-ties, and they may be interesting for you to examine them some time when you are in Philadelphia.

Improved Depth Gauge.

The depth gauge for machinists, illustrated herewith, is composed of a graduated tube and a flat base on which the tool rests when in use. A disk works in the tube, carrying a measuring wire, which projects through the base and also carries a pointer, which indicates the depth measured. The measuring wire is threaded in the disk, so it can be adjusted for wear on the end of the wire. A spiral spring in the tube acts on the disk, forcing the measuring wire through the base its full length.

The spring on the side of the tool acts as an automatic friction stop, holding the measuring wire in any position that it may be forced to while measuring. In using the tool, the wire is first let down its full length, by pressing on the spring on the outside of the tube, which removes the friction from the wire and lets the spiral spring in the tube force it down; then take the tool by the handle at the right of the tube, place the wire in the hole or groove to be measured and press down till the base rests flat on the surface of the work. The pointer indicates the depth.

These tools are graduated in 100ths of an inch on one side of the slot and 64ths of an inch on the other. The one represented by the cut will measure 1½ inches. They are manufactured by W. L. Thompson, 1177 North Fourth street, Springfield, Ill.

Stagnation of Promotion Among Naval Engineers.

Passed assistant engineers of the navy do not seem to have very brilliant prospects of advancement in their business, according to the prevailing progress of promotion. According to the report of the secretary of the navy, nearly forty assistant engineers who were in active service during the war still remain in their present grade, having occupied it from fifteen to seventeen years. Promotion in all departments of the naval service is almost stationary, a condition of matters which generally happens to the belligerent service during a prolonged period of peace. The policy which cuts down the naval armaments below the needs of the country tends to depress the prospects of employes, and in this case widespread dissatisfaction exists among those influenced. This is not to be wondered at, for men entered the naval service with the understanding that they would reach higher positions in a moderate time, and the indefinite postponement of their first promotion inflicts real hardships upon themselves and their families. To relieve the stagnation of promotion the secretary has recommended that officers be required to retire when they reach the age of sixty-two years.

A marine engineer of Clinton, Iowa, writes to the Cincinnati *Marine Journal*, complaining of the trouble caused to the navigation of the upper Mississippi by saw-mill owners continuing to deposit large quantities of saw-dust into the water. He says that in some places they stir up saw-dust so thick that it clogs the valves in their doctors. The consequence is that they have to take their doctors to pieces, and clean their heaters, columns, and pumps before they can go further, which causes much delay and expense.

Getting an Export Trade.

The prevailing depression in some branches of the iron industries of the United States ought to induce our manufacturers to make special efforts to find a market abroad for some portion of their surplus productions. Since the opening out of railroads in Mexico, and their connection with our own railroad system, quite a stimulus has been given to our trade in that direction, with the result that our workshops will build a considerable share of the new machinery needed in Mexico for railroad, mining, and agricultural purposes. But there seems to have been no good reasons why our merchants should have waited for direct railroad communication before they went in vigorously for a share of the Mexican trade. There was good water communication before, and merchandise might have been forwarded in that way just as well as by rail. But there seems to be a singular reluctance among our business men to engage in enterprises which entail water transport. Since our home trade began to offer a good market for the products of our own factories our merchants have habitually neglected foreign business, and where it is not sought it is not found. It is only on this hypothesis that we can account for the singular apathy about following up the trade with Peru, the Argentine Republic, Brazil, and other American countries. The demand for machinery in these States has increased every year, but American workshops make but little for that trade.

The Argentine Republic has made great advances recently in sugar making, and many heavy plants of machinery have been imported to do the work, but this country has reaped no share of the trade. England, France, and Belgium are struggling with each other to obtain the lion's share of this business, which naturally belongs to the United States, and our merchants are doing nothing to obtain any share of the trade.

In neglecting the Central and South American trade our merchants have fallen behind their commercial predecessors. A quarter of a century ago the Astors, and other leading American merchants worked up a good export trade with the countries referred to, and the business was of great value to this country, before it was interrupted by the war.

If our merchants would imitate the methods of their foreign rivals they would relieve the surplus production of our workshops by finding a market abroad. To secure this market, they need not calculate on high profits. If we are to compete with other nations, we must adopt the practice of small profits and quick returns.

A correspondent of the *Mexican Financier* asserts that many false rumors have been started in the mining regions near Chihuahua about the presence of rich gold lodes and placers. Several American miners have been deceived by the reports and expended much time and labor searching for treasures that did not exist.

Pipes, Green Sand Cores, and Hollow Pipe Patterns.

BY THOS. D. WEST.

There are few foundries that do not in some form make more or less pipes, and it is astonishing to note how much faster the same class of pipe work will be made in some shops than in others. This is mainly due to the difference in the facilities and rigging. In some shops a man may have to work harder to make one pipe than he would in others to make four, and as a general thing the shop that could turn out the four would require the least skill. Shops that produce such castings the slowest, are, as a general thing, the ones that have the fewest to make, and therefore cannot afford the expense of getting up labor-saving rigging. There are times when a little outlay in some shops would be the cause of procuring much work, that in the end might result in the manufacture of a good paying specialty.

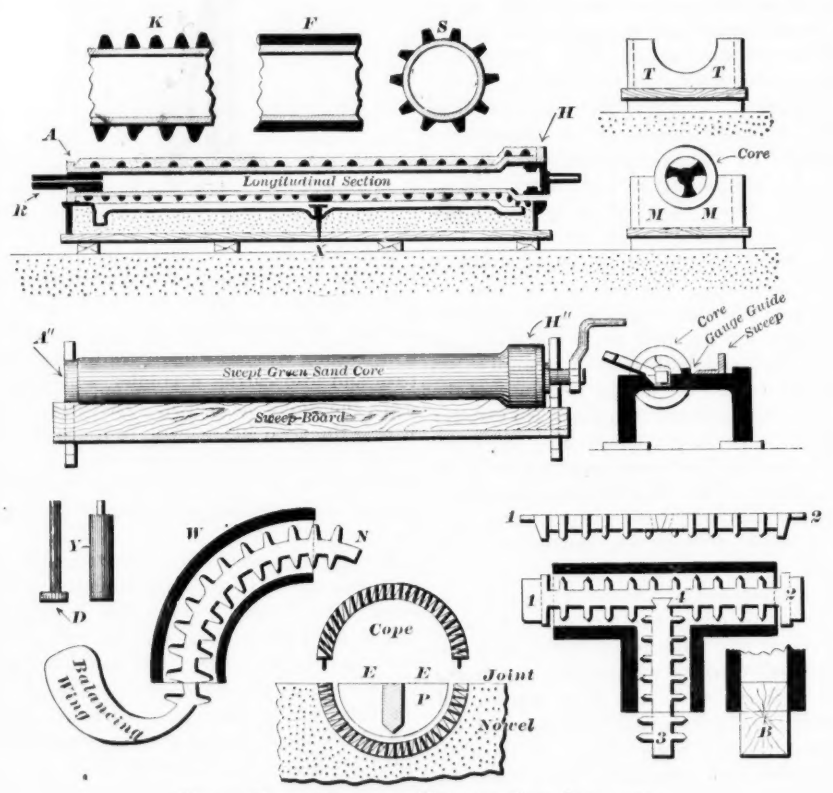
The general jobbing shop way is to make solid dried sand-pipe cores. The extra expense made thereby is the requiring of flour, and sometimes beer or molasses to mix with the sand It also requires much labor to make them, fuel to dry them, and the loss of sand, and after all the time, labor and expense, we do not produce a perfect, round even core.

A plan practiced in some shops that make a specialty of green sand-pipe castings is as illustrated in cut, showing the sweeping of a green sand core. This style of core is sure to produce a round hole, and with rigging properly gotten up, one man can make a large number of cores in a day. The sizes of pipe generally made by this plan range from 3″ up to 12″. In making the core arbors there are two plans adopted. One is to cast arbors having prickers, and the other ribs, upon their surface, to assist in holding on the sand. To show what is meant by ribs, the sections *F* and *S* are given. At *K*, and in longitudinal section of core, prickers are illustrated. As a general thing the ribs are used for the smaller sizes of arbors, on account of their making the arbors stiff, thereby preventing the core from springing up and shutting off the thickness of metal when the mould is poured.

The larger arbors are, in diameter, the more resistance to springing they have when moulds are being poured, so that arbors over five inches in diameter can generally be made stout enough without the ribs. For holding the sand, prickers are to be preferred. The ribs, as it were, separate the sand into sections, whereas the prickers keep it together more in one body. The larger in diameter the longer can pipes be made. A foot pipe would be some 9 feet long; a 3″ pipe 4 feet long, and sizes between in proportion. Of course the stiffer arbors are made the longer they can be. Were chaplets used with this class of cores, as with dry sand cores, they could be made much longer. There is a way whereby chaplets can be used with some green sand cores. That is to have a knob about one inch in area cast or riveted to the arbor, as above the chaplet *X*. This spot being even with the surface of core rests upon the chaplet, thereby causing iron and lead to come together. For the cope a small body of sand is taken out of the core, and some small plates or washers inserted, the top surfaces of which had better be kept $\frac{1}{8}$″, or so, below the core surface. The space around these washers or nuts is then filled in and the core then made as smooth as the rest of its surface. Upon the top of the inserted pieces the cope chaplet rests. In so chapletting cores care is required, for should the chaplets come otherwheres than intended the core would be bursted, and the casting, as well as the arbor, most likely lost. With such work exact measurement and fittings are required. With large diameter pipes there would be danger, by thus chapletting, of bursting the casting, on account of the knob *X*, and the pieces above it, making a brace that would prevent shrinkage. Sometimes there is no danger of the core springing downwards, but there is a tendency to raise. When the lifting strain of the fluid iron comes upon it, in such cases as this, the bottom requiring no chaplet, the knob *X*, could be upon the cope side, and the cores thereon be chapletted down, casting the pipe by having a chaplet only on the cope side.

The reason for using the washers or loose plates instead of a solid body being secured to the arbors, as above *X*, is to allow the arbor to free itself. Were the top the same as bottom there would be immovable iron to iron. By having loose washers or plates the jarring of arbor soon causes it to be free, thereby letting it come out.

Core arbors should be well perforated with small holes, to allow the gases to escape. The thickness of sand upon arbors ranges from $\frac{3}{8}$″ to 1″. The more nearly dry the sand used the better. In sweeping up a core, the process generally is to touch the arbor with clay wash or water, and after being set upon the horses the sweep board is set, sand is packed by hand upon the arbor, after which with a man turning slowly, the sweep board is lightly pressed forward until it strikes the gauge guide which gives the diameter wanted. The arbor ends, *A H*, can be used to give the diameter, but having the core gauged independently of the arbor is to be preferred, as the friction of the turning will wear away the guide, and also more or less vibrate the arbor, thereby often causing the sand to drop.



GREEN SAND CORES AND HOLLOW PIPE PATTERNS.

A point that here might be mentioned is, that the less sleeking done to pipe cores the better. In fact, it is best not to sleek them at all, leaving the surface as it is swept, as the metal lays more kindly to the core.

In casting the larger sized pipes, it is essential that the arbors should have reliable bearings. 3″ up to 4″ pipes could be cast by having sand print bearings, but above this last size the arbor ends, *A H*, would be better if turned up true, so as to exactly fit the flask iron ends, as shown at *M M*. The cut *T T*, shows the end without the core in. The arbors being true, the flask ends would of course require to be the same. By having arbors set in such bearings it is evident that the core will be kept central, and that its weight cannot sink it down, or the liquid iron raise it up; that is, as far as the prints are concerned. It might be well to mention that the pattern prints must fit into the flask ends when moulding the pipes, in order to have the mould central with the flask ends. In making arbors having such iron-end bearings, one, if not both, should be made smaller than the inside of intended pipe, so they may be readily got out of the castings.

The longitudinal section of mould shows a flange on one end and a socket on the other. This is only to illustrate the idea that either kind can be made. In the smaller sizes of pipe it is not necessary that the arbors should be larger at socket end, as shown at *H*. If the arbors are straight their entire length, and the sand reasonably tough, the little extra thickness required to form the socket will hang.

The plug seen at *R*, is inserted for the purpose of lifting the core. Where arbors are large enough to admit a trunnion being riveted on, as seen opposite *R*, it is advisable to do so, as they can be revolved easier. Revolving arbors, by having their whole diameter turn in a bearing, as seen at *A*, cause much friction.

The cuts of elbow and branch pipes illustrate the making of pipes with hollow patterns, they being the same as the castings wanted. At *E E* is shown a sectional view of the pattern. The nowel having been rammed up, the core arbor *P* is then set in and rammed up. The cope part of pattern is then set on, and sand tucked in The joint having been made, the cope is rammed up, and, after being lifted off, the top pattern is drawn. By taking hold of the arbor handles, Nos. 1, 2 and 3, the core is lifted out, the bottom pattern is then drawn and the mould finished. The core is then set back and cope closed. The end of arbor at No. 3 is of a style different from Nos. 1 and 2. Arbors as at Nos. 1 and 2 are handy for small pipe. The arbor is set on the mould board and the nowel half of the pattern over it, and the nowel is rammed up and turned over, the arbor forming its own print. This style is not recommended for heavy cores, as it does not give print enough to hold up very much weight.

The arbor as at No. 3 is of the same form outside the pattern as it is inside. To form prints for such arbors, with hollow patterns, there could be half round blocks, as shown in plan at *B*, rammed up with the nowel half of pattern, and then when the nowel is rolled over, draw out the blocks. This would leave prints formed ready to set in the arbors.

The quarter-turn pipe shows the plan of an arbor made so as to balance the core, the balancing wing projecting beyond the mould preventing the back *W*, from sinking down as it would were both ends of arbor the same as at *N*, and the back nut chapletted. This style of an arbor can, of course, be operated as regards rolling over and print making, the same as the *T* arbor described.

At *Y* is shown a core rod and core made upon it. The head *D*, admits of the core being lifted vertically, and also is a support to the core if rested upon its end. This class of green sand cores can be used vertically or horizontally, and for pipes about one foot long, 2″ or 3″ in diameter, where their manufacture is to be made a specialty, they are worthy of consideration. The cores are rammed in a box endwise, and require to be vented, for which, in some cases, it might be well to have two or three vent holes drilled through the head *D*.

Green-sand cores, as a general thing, require more or less rigging, which is one reason why more shops do not use them. The holes formed by green-sand cores, as a general thing, for smoothness and being true, surpass those made by dry-sand cores, and generally thinner castings can be made with green-sand than with dry-sand cores. The making of green-sand cores often requires much skill. There are many cores being made of dry sand that could be made of green sand, but, like many other things in moulding, it often requires practical experience and good judgment to decide the feasibility of making them.

Reports from Mexico intimate that the last spike in the track-laying of the Mexican Central Railroad will be driven in a few days, and that the authorities are preparing to celebrate the event with a great public banquet and demonstration of joy. A good many parties interested in railroad operations in Mexico would be better pleased to hear that the authorities were bestirring themselves to have laws passed to protect the lives and interests of the men engaged in this industry. A disposition to adjust their laws to the new conditions of civilization represented by the opening of railroad communication, would be accepted as a better testimony of welcome to railroad men than any number of banquets, to be succeeded by vexatious prosecutions and officious interference with the work of operating trains.

Compounding Two Steam Engines.

The following extracts from a letter from the well known builder of compound steam engines, William Coutie, of Troy, N. Y., will be of interest to our readers. Mr. Coutie has been a firm believer in the compound engine, and worked against a good deal of prejudice in this respect for nearly a quarter of a century. The letter was in reply to one from us asking, amongst other things, information about the compounding of engines at Adams, and aside from the interest in this way of increasing power, there are interesting incidental features touched upon by the writer:

* * * The engine you inquired about is a horizontal, with cylinder 40″ bore by 43″ stroke. It is to take steam from a pair of Harris-Corliss engines, 18″x42″, running at 84 revolutions, 60 lbs. boiler pressure. The new engine has a 14 ft. wheel, and as the old ones have a 16 ft. wheel, the new one was to run 97 revolutions, both belting to 6 ft. pulleys on the main shaft. This would give the new engine a volume capacity of 3 to 1, as compared with the old engines. But by mistake they ordered the new pulley for the mill-shaft 6½ feet diameter, so the new engine will have to be run at 88 revolutions, which will make more back pressure on the old engines, and leave more of the total work to be done by the new engine, but we have made it extra strong and well, and the slower speed suits me quite as well.

There is no intermediate chamber except the steam-chest, which is purposely made large. The steam will pass from the new or low-pressure engine through a heater or surface condenser, to heat water for dyeing, &c., so the steam will be used three times, first in the high-pressure engines, next in the new or low-pressure engine, then they extract the remaining heat, as far as practicable, for other purposes. The air-pump—a Knowles condenser—is 50 ft. away from the engine, and is intended to be of sufficient capacity to condense all the steam at such times as the heater is not in use.

The mill in which the engine is located is in Adams, Mass., owned by the Renfrew Manufacturing Company. They manufacture Turkey-red table-cloths, using all Jacquard looms. These are all in one room, and it seems to me it is the largest and busiest room of the kind I ever saw. They are putting in 100 more looms, and an electric-lighting plant that will require 115 horse-power, so there will be work enough for the engines.

* * * * * *

I expect to double the power by the use of the same quantity of steam. We got this contract from the operation of a full com-

pound engine we put in another of the company's mills, and which gave, and continues to give, a horse-power for considerably less than two (2) pounds of coal.

* * * Some of the members of the company for whom we are erecting this engine are amongst the largest and best-known manufacturers in Massachusetts, so we are on trial before New England, but have no fears of the result.

* * * We are now building engine No. 12 on our list (300 horse-power) for the Glen's Falls Paper Mill Company. This company are building a new mill to make twenty tons of paper per day, and they expect to have the most perfect and complete mill in the world; at any rate, they are spending money with the utmost freedom to make it so. Amongst other things to that end, D. H. Tower, of Holyoke, Mass., who has spent his whole life thus far as a paper-mill architect, and as such has designed the finest mills in the country, has an open limit so far as money is concerned. The mill will have four 84″ machines.

Geo. West, of Ballston, N. Y., after some years' trial of the first compound engine we built for him, is now putting in another of our engines.

We are also putting in an engine for Gibbs & Baird, on 106th Street, New York. This engine will not be run until spring.

We have plenty of work and many inquiries about our engines.

* * * * * *

New Method of Bronzing Iron.

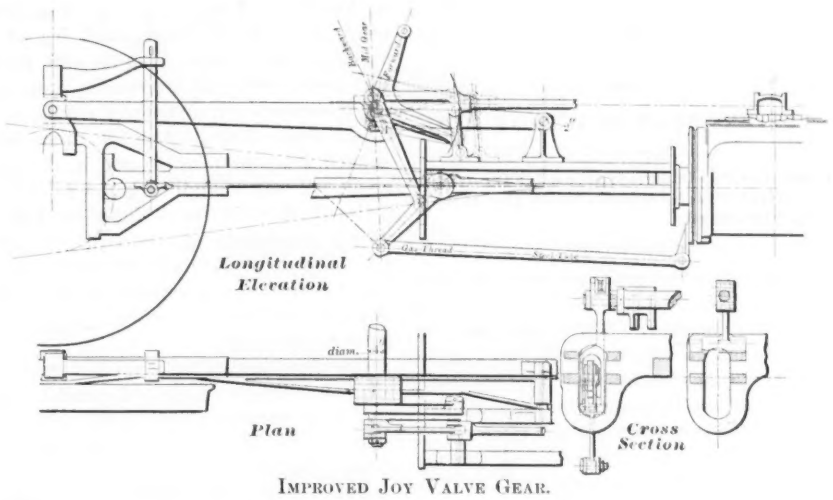
A German technical journal gives the following method of producing a bronze-like surface on iron or steel, which prevents rust: The object to be acted upon must be cleaned so as to take off all oxidation or other impurity. It is then exposed for two or three minutes to the action of the vapors of a heated mixture of hydrochloric acid and nitric acid in equal portions at a temperature ranging from 550 to 650 degrees Fahr. After the objects have cooled they are to be rubbed over with vaseline, and again heated until the vaseline begins to decompose. This treatment with the vaseline has to be repeated once. Should a lighter coloring than bronze be desired, it can be produced by mixing acetic acid with the other acids.

One of the passenger engines belonging to the New York, West Shore, and Buffalo Railway had a close escape from a bad accident last week. When approaching the station at Jersey City, after a fast run, the front axle of the forward tank truck broke in the middle. Both wheels dropped inside the rail and dragged along without damage till the train was stopped. Had the break occurred when the train was running at a high speed, it might have led to disastrous results. It is something astonishing, how often breakages of axles occur when trains are running slow, after making fast runs.

The Basic Process of Steel Making.

The basic process of steel making, which we have heard so much about in the last few years, where a basic lining in the Bessemer converter is utilized to eliminate phosphorus from the metal, has been successfully put into practice by the Pennsylvania Steel Company at Steelton, Pa. By this process they claim to have produced some of the purest steel made in the country, but it proved more costly than the methods of purifying the iron ordinarily used in steel making. They are not doing anything with the basic process at present; but should good qualities of iron rise in price, the basic process will be resorted to for purifying the contents of the converter.

Great engineering enterprises are now becoming so common that works of immense magnitude which, forty years ago, would have been proclaimed far and wide as additions to the great wonders of the world, are now deemed sufficiently noticed by a few short newspaper paragraphs. A new railway bridge about to be built over the St. Lawrence River has received little public attention, yet it will be longer than the famous Victoria bridge.



IMPROVED JOY VALVE GEAR.

Improved Joy Valve Gear.

This engraving shows the Joy Valve Motion with an improvement made to meet certain objections raised to the original motion, as applied to American locomotives. In the Joy motion, as it was put on several locomotives when first introduced into this country, the upper fulcrum point of the vibrating rod *A* was carried in a block working in a slotted link. In practice it was found that this block wore very rapidly, destroying the accurate adjustment of the valve motion. The gear to which the link and block were attached, was supported by a rigid bracket fastened to the frame. As the motion for the valve gear was taken from a point on the connecting rod the rising and falling of the engine on the springs had the effect of lengthening or shortening the valve-moving attachments. This transmitted irregularity of movement to the valve. In the improved motion the sliding block is abandoned and two pins and a fulcrumed rod are substituted. The motion is carried on a bar extending from the spring saddle to a bracket on the forward part of the frame, which is intended to compensate the irregularities formerly caused by the vertical motion of the engine.

This motion has been just put on five tramway motors built in the Baldwin Works for Australia. According to our foreign engineering exchanges the Joy motion is making substantial headway into locomotive practice abroad.

The monthly meeting of the New York Car Builders' club was held in the rooms Liberty Street, New York, on the 20th ult. President Geary presided, and called on C. A. Smith to open the discussion on the carrying capacity of freight cars. Mr. Smith advocated the practice of loading cars to their full capacity, and gave reasons for his belief that the limit of car load had not yet been reached. He held that the practice of increasing the carrying capacity of cars had done much to reduce the expense of moving freight. A lively debate ensued, when both sides of the question were well supported.

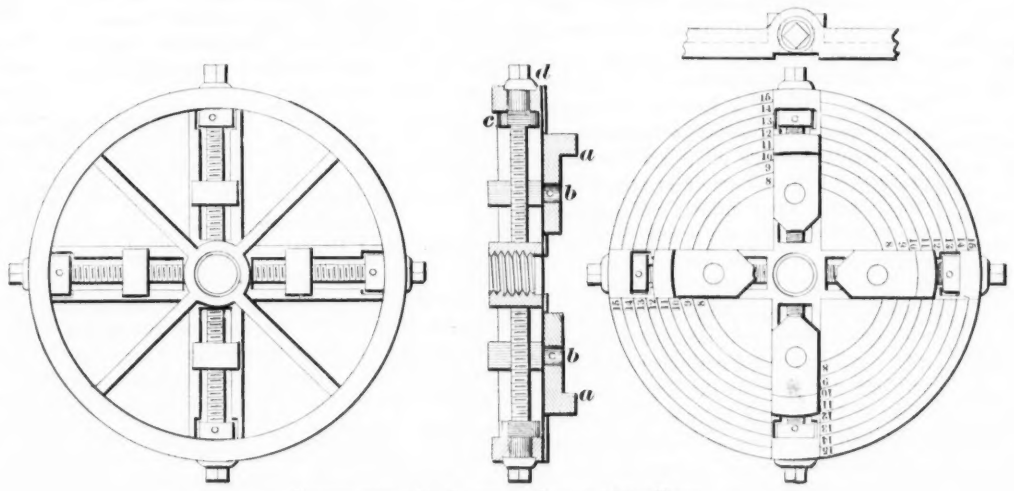
Running a Lathe.

FOURTH PAPER.

BY FRANK H. RICHARDS.

SOMETHING ABOUT CHUCKS.

Of all the appurtenances of the engine lathe, a good independent four-jawed chuck is the most essential. I have seen a lathe "run" without a chuck, or with only an apology for one; so a man may get along through life lacking a leg, or an arm, or an eye; but he would be a strange fellow who would argue that the missing member was not necessary. The chuck that I want should be made for the lathe, and be considered a part of it. It is far more needed and, where it exists, is much more constantly used than the steady rest that all the builders furnish. When I put a lathe upon the market, a chuck as good as I can make, of the best material, and stiff and strong enough to hold firmly any work adapted to the lathe, will be a part of it. If the purchaser positively will not take the chuck, it will give me a chance for another discount upon the lathe, and if discounts will not sell a thing the case is hopeless.



CHUCK FOR 18″ LATHE. SCALE 1½″ = FOOT.

We have been doing much in these days toward the improvement of the engine lathe, especially in the way of strength and stiffness; but to gain a sweeping success we must advance our forces all along the line. The lathe is still no stronger than the weakest part of it, or of its attachments. I can show you a 26″ lathe, with noble V's 1½″ deep on the side, to which the purchaser's attention is ostentatiously directed as affording a liberal wearing surface; but the lathe is built to sell, and the carriage is planed so that it laps upon the V's not more than ¼″; this point the purchaser must discover for himself. So with the chucks which are in use upon too many of our lathes. The success of many a job depends upon our ability to hold it firmly in the chuck. A chuck is, in fact, a vise for a special purpose, and a vise is throughout our literature typical of firmness and tenacity of grip; but all romance and all history would be upset if we were to let the conquering hero hold his vanquished foe in a patent combination chuck, instead of in the time-tried and time-honored old vise.

It is easy enough to have our fling at things as they are, but it is in no flippant or captious spirit I assert that there is really no good chuck in the market; and I am inclined to think that there never will be. The system is wrong, notwithstanding that there is more money wasted in this direction than upon any other class of machinists' supplies. The ready-made chuck holds no better relation to the best workmanship than ready-made clothing does to correct dressing. Strength, which is the first essential in the principal chuck of the lathe, is to be secured not alone by weight of metal, but fully as much in the advantageous disposition of the leverages and strains to which it is subject. And strength means something more than ability to withstand actual fracture. For the purposes of a chuck, it should mean the nearest possible approach to absolute rigidity. Often the springing and chattering of a job are so exasperating that an actual breakdown brings with it a sense of relief.

The mode of mounting the ready-made chuck is its first fatal characteristic. The "Autocrat of the Breakfast Table" says—and every machinist is a better machinist for having read such a book as that—: "The nation that shortens its weapons lengthens its boundaries." The Romans, with their short swords, conquered all the fellows who used to poke at their enemies with twelve-foot spears. So we should hold our work as closely as possible to the headstock. The chuck should have a good stout hub of its own, threaded to fit the lathe spindle snugly; the front of the chuck plate should come very little over the end of the spindle, then the screws for operating the dogs are carried back over the spindle, and thus the chuck is kept compact and the work is held as closely to the head as possible. The chuck you buy, which it is so easy and handy to buy, is bolted to a weak little flange by three or four flimsy little bolts, and the whole thickness of the chuck overhangs the spindle, and apparently little thought has been given to the keeping of it as thin as possible. The combination principle aggravates this evil, carrying the chuck still farther from the spindle, being more springy in itself, and its complication and multiplicity of parts leading to frequent derangement.

The combination chuck is, after all, like all the other bad things in the world, and most of the good ones—but a compromise. It only partly does what it sets out to do. If a thing is worth doing, it is worth doing thoroughly; and the combination chuck of the market stops far short of that. No one as yet has had the cheek—and I have often wondered at it—to offer the mechanical world the ideal combination chuck. This would consist, starting from the front, of the usual three or four independent jaws, next behind this would be the scroll or other device for the "universal" movement, then there should be two slides and adjusting screws, one behind the other and moving at right angles; and back of all the chuck should have a spherical mounting, or ball and socket joint, with suitable adjusting and clamping screws for tilting the chuck at any desired angle and in any direction. With such a chuck as this, and plenty of chalk and time, and the boundless puttering patience of the imbecile workman, it would be possible to bring a piece of work nearly true; then the chatter marks that could be produced upon it might be found useful in getting out a new edition of the United States postal notes.

The universal principle, as applied to chucks, is a snare and a delusion. A newly-fledged apprentice may be pardoned for his faith in them, just as he trusts implicitly that the engine lathe will turn straight; and so he can start his cut and sit down to rest until the tool runs up and hits the dog, while you or I upon a similar piece of work must stand over it with our calipers. I never saw a universal chuck. I shall never, I trust, be guilty of the folly of looking for one. It never came in my way to do the finest of

machine work, but I have encountered lots of jobs that couldn't be looked at by the very best universal chuck that was ever put upon the market. The Horton chuck is the best of its race, but when you place anything in in it you can vary it perceptibly as you tighten one or another of its screws. You can't take a piece out of the chuck and return it, and have it run precisely the same a second time.

I do not want to be understood as saying more than I mean. The universal chuck may be the best mode of holding some classes of work. It may often enable us to dispense with skill in our operations; but it should be remembered that, at the same time, it is inimical to any development of skill. The universal chuck is never fine—even if finely made—and it is never strong. They all announce their weakness by the wrenches that accompany them. They are made of such a size and shape and material that it is impossible to produce a respectable squeeze with them.

I advocate the most liberal expenditure in the matter of shop facilities, but I would buy these chucks sparingly. The accumulations in shops that have bought them most recklessly are quite disheartening. They never wear out. Not that they last eternally; they break or they bend, or parts of them get lost before they have time to think of getting worn out. They can only be repaired by special tools, which cost too much, and the chucks cost too much for any one to have the heart to throw them away; and so they eternally hang around, a worthless and unsightly nuisance.

I offer herewith a sketch of a chuck for an 18″ lathe. Whatever of novelty there may be about this chuck consists in the fact that there is not the slightest novelty about it. I suppose the construction of it will be sufficiently evident. The collar *d* is forged solid upon the screw. The round nut or collar *c* is fitted upon the screw with a fine thread, and fastened by a slightly tapered pin through it. In making the chuck, the stem of the nut *b*, where it goes through the jaw, might be left long enough to have a nut outside the jaw. Then, by this nut the jaw could be held snugly in place until the cross-pin hole could be drilled and reamed, and the pin fitted to hold the jaw in place. The jaw would, by this treatment, be brought to hug the slide too snugly, and a little scraping would make an excellent fit. Then the projecting end of the nut could be cut off. All of the chuck except the main casting should be made of steel; the jaws, of course, of cast steel and hardened. If this chuck be truly made, the jaws are perfectly reversible. In the market chucks the jaws of many of them are readily reversible, but too much is sacrificed to accomplish it. The screws of them are large in the thread and small in the shank, and the work cannot be screwed up tightly by them. The jaws of that class of chuck also soon wear loose in their slides, and tip out and bind themselves when any strain is put upon them. The jaws of this chuck have travel enough for the outer lug to bite all that the inner point will not seize. This chuck has the not insignificant merit of being easily *wipable* and *oilable*.

The measured circles marked upon the face of the chuck are of great service in using it. A mark cut upon the side of the jaw from the bite *a* of the outer lug in to the face of the chuck, will enable the operator to set the jaws accurately. The inner end of the jaw always measures a circle 7″ less than the lug *a*. The last operation upon the chuck should be the squaring the ends of the screws for the wrench. When the jaws of the chuck are adjusted perfectly concentric, the squares upon the screws should be made all to stand in the same relative position, and the corresponding side of each square conspicuously marked. Then, by attention to the circles upon the face of the chuck and the position of the squares upon the heads of the screws, work can be chucked as accurately, almost as readily and far more securely, than in the best "universal" chuck. To cut the squares accurately, a piece could be set in the chuck and carefully adjusted by a tool in contact with the surface of it, tightening the screws by a dog or a pipe wrench. Then the lathe may be set in motion and one side of each square faced by a tool, and the other sides of the squares may be easily made from these.

LETTERS FROM PRACTICAL MEN.

Gear Teeth—Diametral and Circumferential Pitch—Obstacles in the Way of a Standard.

Editor American Machinist:

If the subject of gearing is not exhausted, I would suggest that the discussion has been somewhat one-sided. Those who have expressed their views in your columns can see no merit in the circumferential pitch system.

In gears used upon machine tools and light work in general, the diametral pitch system is decidedly the better; and if all the machinery and patterns in existence could be run through a cupola and redesigned, it might, and probably would, be adopted as the standard. But gears are constantly being made to replace those which break or wear out, made on the circumferential pitch system; and in many cases, to change the pitch would necessitate changing the original velocities, or moving the axis of the gears—the latter, perhaps, costing more than the gears.

The advantages of the diametral pitch are not so great, however, as many claim. When the pitch becomes greater than "one per inch," its simplicity disappears. To illustrate: Suppose we wish to make a gear with a pitch twice as great as "one per inch;" it then becomes one-half of "one per inch," and to carry out the proportions we might say $\frac{1}{2} \times 8 = 4$, equals the number of inches to be added to the pitch diameter of the gear. But the calculation is not so simple as in the circumferential pitch system, where we can in all cases make the working depth of tooth equal—say $\frac{6}{10}$ of the pitch; then $\frac{6}{10}$ of the pitch added to the pitch diameter equals the outside diameter of the gear. As the difference between "one per inch" and one-half of "one per inch" is so great, fractional pitches still more troublesome would occur.

In reading the letters upon the subject in your columns, it would be inferred that the experience of the writers had been limited to gearing of the machine tool class, in which the diametral system is certainly preferable. Mr. Geo. B. Grant, in issue of September 15, says "the diametral system has displaced the old circumferential pitch system except in the largest and coarsest description of work." It is possible the "largest and coarsest description" may be a greater proportion of the whole than Mr. Grant is aware of. There are many gears made which are coarse enough, in all conscience; but a gear that will successfully transmit 500 horse-power, with a velocity at its periphery of 4,000 feet per minute, will hardly be considered a "coarse job;" and as much knowledge in designing, and as much skill in constructing, may be required as in the case of gears for a 16″ lathe or a Waterbury clock.

One serious obstacle in the way of the proposed standard is the fact that there are establishments which have many thousands of dollars invested in gear patterns made on the circumferential pitch system, and it will take something besides argument and theory to induce them to adopt the proposed standard.

I would be very glad to see adopted a universal standard for the proportions of gears, but I think some time will elapse before it is brought about. GORDON.

Those Drawing Instruments.

Editor American Machinist:

Your correspondent, "Craftsman," in a recent issue, spoke of numerous angles, projections, &c., on drawing instruments, and thought they should be removed. He is quite right. It seems to be one of the delights of Swiss makers to put them on their tools—the higher the price of the tool, the more angles, &c., you get. Swiss makers residing in this country do the same thing, and others copy from them. These little projections are neither pleasant to the touch, nor cleanly, and they are utterly without use except to run up the expense of the instrument.

When the perfect American tool is made by Americans, I hope to see an ideal instrument, with, for instance, each leg of the dividers a pretty taper from the stiff joint to the point, with all necessary projections nicely rounded off, and never cut in, as the Swiss make theirs. Another thing which seemed most peculiar to me is the notch about half way down the leg of a pair of good Swiss dividers, cutting the leg about half off, utterly regardless of consequences as to springing. If that thin part is strong enough (for the weakest part represents the strength of a tool) then why not reduce the remaining parts accordingly?

The nicest tools I have handled were a set of Swiss dividers (pen and pencil), which had been carefully filed down from their former selves, and nicely rounded up on all sides of the leg. The hand could move from one end to the other without encountering any harsh projection, and it was a pleasure to work with them. The matter should be investigated by the manufacturers.

DRAFTSMAN.

Faults in Apron Lathes.

Editor American Machinist:

In a recent issue I saw an article entitled, "Faults in Aprons for Lathes," in which it was stated that the gears should be outside, where they could be oiled and cleaned more readily. My experience teaches me that the fault does not lie in the fact that they are *not* exposed, but that they are exposed at all. They are usually covered in front, but open at the ends, and in brushing the chips and dirt from that, or an adjoining lathe, they are thrown almost directly into the opening and upon the gears. The latter being greasy, the chips stick fast to them.

I have lathes on which the gears in the apron are covered both at the front and ends, and find no cause for complaint, except the difficulty in oiling them. The apron should be attached to the carriage in such a manner that it can, by loosening two or more screws, be made to swing upon a stool or other support, and then be oiled with ease.

I think the idea of having the gears exposed is taking a step backward instead of forward in the arts. The practice ought to be that no gears should be exposed that can be as easily covered.

If gears are exposed it gives an ungainly appearance to the work, and is liable to very serious results. J. BIRKENHEAD.

Mansfield, Mass.

The First Practical Steam Engine.

For nearly two thousand years the potential power of water in the form of steam was known to mankind. Generations of scholars and scientists found the subject of steam an amusing theme for learned speculation or for amusing experiment. Philosophers endeavored to harness the giant Steam to useful occupations, but their harness proved unequal to the task; and, after numerous fruitless attempts to make a steam engine that would be cheaper than the work of animals, the learned world settled down to the belief that steam could not be applied to commercial purposes. When theoretical investigators gave up steam as beyond their control, it fell to the hands of a working blacksmith to make the steam engine a commercial success. Till Thomas Newcomen directed his attention to steam, the attempts to make it do work took impracticable forms. He made an engine with a piston working in a cylinder, and transmitting power to a walking beam. That was in the beginning of the eighteenth century, when mechanical skill was at a low ebb. The engine was exceedingly crude, but it succeeded in pumping mines clear of water that previously had defied the means at command for doing that work. That engine possessed the essential principle of all succeeding steam engines—the cylinder and piston. Engines of this form were built for pumping purposes all over Europe, and quite a number of them came to America before any radical improvement was made on the engine. Yet so little honor was done the man who first forged harness for the giant Steam that even the time of his death is unknown, and his last resting-place remains unnoticed. Newcomen was really the father of mechanical engineering, yet his disciples, who are now legion, cannot point to the spot where his dust reposes. He lived in a time when it had not become the fashion to honor the heroes of industry, and Newcomen was known only as a man who was not contented with the appliances his forefathers had been satisfied to use to the honor and glory of England. The Royal Society for the Promotion of Science did not think Newcomen's work worthy of notice. There was too much of the practical about his invention to secure attention from a body which a generation later censured a member for taking part in what they deemed the vulgar occupation of road-making.

Among the improvements which will add greatly to the comforts and pleasures of Mexican life attendant upon the completion of railway communication with the United States will be the introduction of the artistic furniture and household decorations in which that country now excels. Mexicans are a people of natural good taste, but the difficulties of communication have obliged them to put up with whatever things foreign dealers have chosen to impose upon them; and though willing to pay the best prices, these things have generally been goods rated as second-class and unfashionable in the markets whence they came and of a flashy, unsubstantial character designed for provincial consumers. But now thousands of Mexicans will take advantage of the new facilities for travel and will be quick to perceive the beauty and utility of the articles in use in the great American centers of wealth and taste, and will demand like articles for themselves in place of the shabby, unenduring things with which they are now served. The beauty of a modern American family room of the best class, with carpets, wall-paper and furniture of the most delicate color-tones, and all parts in thorough harmony, will strike them like a revelation.—*Mexican Financier.*

The committee appointed by the Public Water Board of Lynn, Mass., to test the pump recently furnished that city by the Deane Steam Pump Company of Holyoke, Mass., has made its report, the substance of which is as follows:

"The machine is a horizontal duplex compound engine and pump of the following dimensions: Diameter of high pressure cylinder, 10 inches; diameter of low pressure cylinder, 30 inches; diameter of water pistons or plungers, 17½ inches; diameter of water piston-rod, 3 inches; actual length of stroke, 1.99 feet. The vacuum pump is the independent pattern, Deane's patent. Observations were made every 30 minutes during the test, which was of 24 hours' duration. Water pressure, average observations, 57.13 lbs.; gauge to the surface of the water in the well, reduced to pounds, 8; allowance for friction, pound, 1; total pressure, 66.13 lbs.; area of plungers, 17½in., equal to 240.53″; area of rod, 7.06″; area of plungers minus one-half of the rod, 237″; revolutions in 24 hours, 32,738; total foot pounds, 4,084,240,197; amount of coal consumed, pounds, 6,533.5; duty in foot pounds per 100 pounds of coal, 62,512,285."

A new form of earth excavator has been patented by Charles A. Smith, of Chicago, Ill. It is intended to take the place of the ordinary steam shovel, and consists of a revolving chain of iron or steel diggers. The chain works round a movable frame whose apex can be lowered into the material to be excavated. When power is applied to suitable mechanism for revolving the chain, each digger, which is shaped like a double plow board, fills its inside cavity with the material worked on and carries it round and deposits it in a receptacle supplied for the purpose. The machine looks like a bucket dredger applied for land purposes.

The cantilever bridge across the Niagara River, recently illustrated in the AMERICAN MACHINIST, has been tested and pronounced satisfactory. It is now proposed to build another across the same river at Lewiston.

Personal Recollections.

BY S. W. GOODYEAR.

SEWING MACHINES.

In my last letter I discover that I am made to say that there was "an adjustable cutter on the sliding spindle" of the cam-cutting machine. By reading "collar" for "cutter," the description will be correct.

But it is probable that your readers may tire of reading descriptions of methods adopted a quarter of a century ago, more especially as the sewing machine in question was one of the many short-lived inventions, in that line, which did its share towards educating the public up to the necessity of sewing with machines, but after a few years was obliged to withdraw from the field. Its withdrawal was the natural result of the aggregation of capital and combination of interests, through which the millions of people, who got their first itching for a *good* sewing machine from experience with or observation of some of the many *cheap* (?) machines, have been supplied with machines which work perfectly, save labor, give comfort, and are as thoroughly adapted to the use for which they are intended as any mechanism which can be found in use for any purpose whatever. I will, with a few words intended to emphasize my thorough belief in fixed methods, let the old sewing machine—long since out of the market—rest in peace.

PIECE WORK.

In due season appliances were provided for producing by piece work—*when properly used*—all the different parts of the machine, in such state of perfection that they would "come together and work." That stage had been reached where proprietors—theoretical mechanics—rub their hands together in a self-congratulatory manner, and say to their friends, "Costs no more to do a thing right than to do it wrong. Got everything fixed now, so that nothing can come wrong. Shall have all the work done by the piece, as soon as we can decide about prices;" and with much care bestowed upon learning how much work could be produced in a given time, with the new appliances, the work was all "pieced out" at prices less by thirty to fifty per cent. than could be made to appear by the best efforts at day work; some of it at more than ninety per cent. less than the cost in the old-fashioned way had been.

Surely the situation must have been very satisfactory, does some reader say? Tools that can't go wrong; work all done by the piece; nothing to worry superintendent or foreman now. Let's see. Here are the jigs which were used for drilling the holes transversely through the hubs of the cams, and through the shafts for the reception of the pins, which were to hold the cams in their respective positions on the shafts. Those jigs were marvels of accuracy. Tested by the man who made them and afterwards put in practical use in the hands of a careful "by-the-day" workman, it had been found that those holes could be drilled so nearly central that the pin-hole in any cam, when the cam was slipped on any shaft, would match the pin-holes through the shaft.

For a time after piecing out the work all went well. Proprietors were gratified; workmen were pleased to be able to earn better wages, most of them taking great interest in having their work come out just right, and each feeling an honest pride in doing his part of such good work. The situation was very satisfactory all around.

REDUCTION OF PRICES.

But the time came when proprietors thought too much money was being paid out. Pressure was brought to bear upon me to cut down prices paid for all work in which the books showed an advance of from thirty to fifty per cent. in wages paid for piece work over what had been paid to the same men by the day. I explained, that while it was true that some men were earning from two dollars to two and a quarter per day, who formerly worked contentedly by the day for a dollar and a half, or one dollar and seventy-five cents, it was at the same time true that they were doing for a given amount of money fifty per cent. more work than it had been possible to get from them when they worked by the day, or than could be got from the same men if put back on day work.

A little inconsistent seemed the statements made in reply to my reasoning: First, "that the man who would not do just as much work in a given time by the day, as he would do by the piece, was not honest." Second, "that if the piece work prices should be cut down thirty per cent., or sufficient to force the men to do just as much work as they were now doing to earn their old 'by-the-day' wages, they would soon work up to earning the same pay which they were now getting, and we are willing, of course, if a man works hard by the piece, that he should make an advance on day wages."

To my expression of fear that the urged reduction of prices would cause a deterioration in the quality of work, came the reply: "Make every man understand, that there must not be the slightest falling off in quality of work, and, if necessary to enforce this rule, deduct from any man's account all pay for inferior work, and charge to his account all material spoiled by him."

I modestly intimated that, as my judgment had been considered good in the direction of getting up tools and appliances, having been granted carte-blanche in the matter of methods and expenses, and having in about one year reduced the cost of manufacture in the labor account department some seventy-five per cent., I ought to be considered competent to judge as to what were suitable prices to pay for the different jobs of work, and that if my management was not entirely satisfactory, I was ready to resign at any moment. To this came the reply: "We are perfectly satisfied; we fully appreciate and feel duly grateful for what you have done; we don't want you to think of leaving us, want you to stay with us as long as you live, if you will; we have full confidence in your judgment, mechanically; but in this matter of wages—of dollars and cents—as appears on our books, we feel that we have a right, as proprietors, to decide, and in doing so, that we do not interfere with your rights as mechanical superintendent."

The prices were reduced. The men soon worked up to the same pay made before the reduction. That is, those of them who did not throw up their jobs. Where this occurred, their places were filled by green hands, who, having to learn to do the work and struggle to make wages at the same time at the reduced prices, never learned to do the work as well as those whom they succeeded. The latter, having had some experience by the day, and having long worked by the piece, at the greater price, had already learned all the methods and motions at an easy pace, which simply needed to be quickened, as the pure-gaited trotter goes from the walk to the jog, and from that through all the accelerated action down to 2.20 gait, and still the gait is all the time the same, only quicker.

But the gait of the trotter must be pure. In the different rates of speed all the way down from three minutes to "below twenty," the gait must be right, or the "below twenty" will never be reached at a trotting gait, and *in trotting, running don't count.*

Not long after the reduction the senior partner of the firm escorted some visitors through the works, having invited me to accompany them to explain the different processes. All went well till the assembling and setting up department was reached. Many times before had a similar tour been made with admiring visitors, who had been told by the smiling proprietor that, "with our appliances and methods nothing can possibly come wrong," and the setting-up department had been shown up with especial pride, as proof of the entire correctness of the statement. The attention of the visitors was called to the manner in which everything came together. "This shaft, on which these three cams go, has the three pin holes drilled through it, so nearly central, and the holes through the hubs of the cams are so nearly correct, that there is nothing to do but to slip a cam on to its place, and take one of these pins, which we have cut up by the thousand, and the end slightly beveled, and drive it in." Horrors! at just this point a man was discovered with a cam in its place on a shaft, and reaming out the pin hole to make it match, the hole when done needing a pin nearly a third larger than the regular size, a supply of the larger pins showing that this was not the first time that this had been done.

CHEAP HELP.

Surprise, mortification, indignation, were all manifest in the face of my worthy employer. "Why does this man have to ream out these holes, and put in larger pins?" said he. Said I: "Because the holes don't match." "But that is not what I *ask* you; I can *see* that. *Why* don't they match? I thought you had tools that would *make them come right.*" I replied: "I have, when properly used; these holes can be drilled now just as accurately as when the tools were first made." "Then," said he, with the air of a man who thoroughly understood the situation, "it's your duty, which we shall expect you to perform, to see that this work is done right?" Do I need to explain the situation? Don't every mechanic know that the hackneyed phrases, "Cheap help as good as any." "One man as good as another." "Just as easy to do work right as to do it wrong." "Nobody can help doing it right, only give them the right tools," and scores of other similar statements, are perfect bosh and nonsense? Don't every man, who knows anything about drilling small holes, know that if too much pressure is put on the drill in an attempt to do too much in a given time, the drill will "run out"? Don't every man who runs a milling machine know that, no matter how perfect in construction and adjustment cutters and holding jaws may be, to neglect to clear the jaws from chips and get each piece of work "down," will insure bad work? In running milling machines, nothing is more necessary than a suitable brush for removing all chips from sunk jaws, and time must be taken to use it properly, and to get each piece down to its proper bearing before starting a cut. Time should be taken to thoroughly clean all cutters, collets, arbors and collars immediately after using, while the oil is limpid and easily removed, as by putting them up dirty they will be gummed up, so that it will be difficult to clean them when wanted; and, in the case of gang mills, if put on the arbor by careless hands, the gum may entirely change the adjustment and resultant work.

To put it plainly in a few words: Those very appliances, which are supposed by some to insure perfect work, *must be used just right*, and to adopt their use is not to relieve superintendents and foremen from care, but to impose upon them new burdens in constantly keeping all hands up to their duties; while proprietors who are not mechanics—who are ready to say to mechanical superintendents, when called upon to inspect new devices, either prospective or complete, "We know nothing about mechanical matters; you can not explain such things to us so that we can understand them; we wish to leave such matters to you, but when you are ready to produce the work, when it comes to a question of dollars and cents and results, we shall know how to deal with it,"—should be careful not to move too soon in the direction of cutting down prices paid for piece work, in opposition to the wishes and judgment of practical men,

NEW UNIVERSAL COUNTERSINK.

WE, US, AND OURS.

Investigation will show that those manufacturing concerns having work done by the piece, who have pursued a liberal policy with their contractors and help generally, keeping all hands in a frame of mind to say, "*we, us, ours*," in speaking of all mechanical matters connected with the business, taking pride not only in their own share in it, but in the general good quality of all the work and success of the company, and feeling that they are well paid for their labor, knowing that any improvement in methods or appliances which they may make to increase the amount of work produced will be a benefit to them instead of being seized upon by the company as a pretext for a cut-down—have been the most successful financially, have furnished their customers the most satisfactory goods, price and quality considered; and, not least, have greatly benefited society by elevating to positions of competence, independence—wealth, even—many of their employes.

On the other hand, cases are not rare where the policy of cutting down has been carried to that extreme that each piece workman says, with clenched teeth, "There is no use trying to improve facilities here, or putting forth extra efforts to turn out more work, for they will cut us down the moment we earn above a certain amount, no matter how much they are making out of us." By this means the company are cut off from one of the most prolific sources of improvement in facilities, *i. e.*, the thinking, active, inventive brain of the employe; for why should the mechanic make improvements simply for the benefit of his employer?

Between the "*we, us, our*," of the mechanic, which heartily takes in his employer and business and all pertaining to it, and the "*we, us, our*" of the mechanic applied only to those of his own class, with a spiteful "*they*" for employers, there is a wonderful difference.

From pursuing a policy leading to the last-mentioned state of feeling there can be no doubt that many concerns have failed. Where the best possible feeling exists between employed and employer, there the best results can be had. He who teaches that there is a natural conflict between employer and employed—between labor and capital—or by his action causes a breach or ill-feeling between the two needlessly, is an enemy to his race.

New Universal Countersink.

This tool deserves the name of "universal" from the fact that it is adjustable for use with different size drills or gimlets, the one here shown being adapted for sizes from $\frac{3}{16}''$ down to the smallest sizes made. The two sides of the countersink are alike; and, as will be seen from the engraving, one edge of each side is longer than the other, thus giving the cutting lip the bevel.

The blocks should be adjusted, when used with a twist drill, so that the cutting lip will come close to the cutting edge of the drill. If this precaution is not observed, the small chips will curl in on top of the drill, between it and the countersink, and gradually choke up. On the other hand, if they are put on properly, the chips will follow the flute of the drill and give no trouble.

This countersink not only prepares the place for the screw head, but also gauges the depth of the hole at the same time, an advantage that all will appreciate. One of the important features of this tool is that any one can take it off, sharpen it on an emery wheel, grindstone or oilstone, and put it on again very quickly. It is made by the Cleveland Twist Drill Co., 24 to 26 West Street, Cleveland, Ohio.

French manufacturers who are making strenuous efforts to secure a large share of the trade in supplying Mexico with machinery, have taken a curious method of furthering their desires. Fearing that Mexican merchants may not be properly impressed with the importance of France, they have sent out circulars describing the principal current French enterprises and the diplomas Frenchmen have gained at industrial exhibitions for superior work.

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Unsettled Questions in Steam Engineering.

Any individual or society that will settle definitely one of a dozen points upon which the best engineers are sadly at variance, will do a good work in the way of advancing the science of steam engineering. The theory of steam engineering is about as well understood as it ever will be, until experiment furnishes more facts with which to formulate theory; in fact what of theory there is, when reduced to practice, is little better than delusion. Men have learned to build good steam engines, as the term is accepted, by hard experience, and they must continue to learn in the same way, with more of failure than of success, in the present state of exact knowledge on the subject. The constant repetition of experience is, to say the least, expensive. Ideas directly opposite one another are common, and what is shown to be wrong to-day, is demonstrated to be right to-morrow. One who tries to learn from current opinion will find himself puzzled, or provided with an accommodating assortment, discouraging in its variety, from which to select. Diverse opinions are held by intelligent engineers as to the economy of cutting off at different points in the stroke, and no two seem willing to agree upon the economic value of compression, while some claim it has no such value. Steam jacketing has its advocates and its adversaries, and what seems curious, and is discouraging, to the student, is that he may have read in the same week—perhaps in the same journal—of its entire success, and its absolute failure. Superheating is in the same category, and after ten years' controversy, high speed and low speed are each the most economical, while those who adopt a happy mean are perhaps the best satisfied of any.

Perhaps the difficulty in the individual attempts that have been made has been that too many experiments have been tried at one time. No one believes that where steam jacketing, for instance, has shown economy in one instance and the reverse in another that there was not sufficient reason why it was so, but the knowledge of what the reason really was is too obscure to be of practical value. There are theories—enough and to spare—on the subject, but their foundation is destroyed about once a year. Without underrating the difficulties in the way, it may be assumed that this could, by experiment, be settled so that it might be definitely known under what conditions, if any, it would pay to go to the expense of a steam jacket, and under what conditions it would be valueless, or worse. So with superheat, compression, point of cut-off, cylinder condensation, &c., &c. Buyers of steam engines, as well as builders and engineers, would be interested in a definite settlement of all or any one of these questions, unsystematic experiments upon which cost thousands of dollars yearly. But who shall settle them?

It would be fortunate if some society of standing, like the American Society of Mechanical Engineers, could conduct experiments to that end. Experiments complete enough to settle any one of these vexed and vexing questions, made on the authority of such a society would have more value than all the theorizing on the subject of steam engineering that will ever come before it. Perhaps—but of this we are by no means sure—this is not practicable at present.

There is one idea that suggests itself: Competitive tests of steam engines at industrial exhibitions are in disrepute. It is argued—probably correctly—that such tests settle nothing. Beyond doubt they were advantageous at one time in adding to the interest in such exhibitions. Why not then devote money equal to that formerly expended on such tests to experiments of lasting value and general usefulness? Let the management of any one of the great exhibitions of this class announce that they will at their next exhibition cause to be conducted experiments sufficient to settle the economy of compression, for example. They will have no difficulty in securing, gratis, the use of all the appliances required, and the announcement will create an interest they are not accustomed to. Another year let them determine where steam ought to be cut off, and so on. In this way the exhibition would make for itself a position of prominence, and secure a positive lease of continuance. The value of such experiments, accurately conducted, would be too great to admit the question of their discontinuance.

Speaking of the prejudice that existed only a few years ago against high belt speed—speed that would at the present time be considered common or even slow—an engineer relates his experience in speeding up a large mill engine. The engine being overloaded at its present speed, by his advice it was speeded higher. Upon starting up after the change, there was an unaccountable noise from the belt, which those present attributed to the high-belt speed. The engineer being busy about the engine, advised that they look elsewhere for the trouble, and, while still too much occupied to investigate the cause of the noise, about a yard of plastering came tumbling down, filling the air with a cloud of dust, and bringing about a not entirely orderly retreat of every one but the engineer, who had advised the change, and was superintending the starting up at the increased speed. Stopping the engines by means of the governor rod, and looking around, he found that when changing the pulleys on the line shaft the wall had not been cut away sufficiently, and as a consequence that the belt came in contact with a timber, with the result mentioned. Cutting away the wall removed all objections to the increased belt speed.

Railroad Commissioners Want Locomotive Boilers Inspected.

Report says that the Railroad Commissioners of the State of New York are considering the desirability of recommending the passage of a law requiring the railroad companies within the State to have the boilers of their locomotives periodically inspected by officials appointed for that purpose. We consider the position of railroad commissioner would be a useless sinecure, unless the parties holding the appointment exerted their influence to decrease the dangers connected with railroad operating; but we think that the proposal to substitute State inspection for the personal responsibility of experienced and efficient mechanics is extremely pernicious. Any excuse for the State passing laws to permit interference with private business is based on the fact that public safety sometimes demands intrusion upon personal liberty. Locomotive boilers are so well managed and so carefully controlled under private responsibility, that they cause less damage to life and property by explosions than the boilers belonging to any other department of industry. This is admitted to be true, while locomotive boilers are subjected to working conditions more trying than have to be endured by any other form of boiler in common use.

State inspection of boilers has not proved such a gratifying success as a means of preventing accidents, that it should be extended beyond its present limits without serious consideration. Boilers in the hands of many steam users are so ignorantly managed that the periodical visit of an efficient inspector may prevent disaster; but the fact that a second party is watching the boiler, and has certified as to its strength, often has the effect of dissipating the sense of responsibility of the owner. He concludes that the inspector's certificate will shield him from all blame should any accident happen to the boiler, and he puts a cheap, incompetent man in charge, trusting to his good luck. Other boiler users, better able to look after their boilers, allow themselves to be lulled into false security through the visits of a boiler inspector.

Thus far, master mechanics and roundhouse foremen have had no State official to excuse them from making rigid examination of boilers to see that they are safe, and no duties of the kind have been more satisfactorily performed. Every railroad of any standing has foremen boiler makers thoroughly competent in their business, and they are much better able to judge as to the needs of boilers than inspectors appointed through political influence would be. Locomotive boilers are difficult to inspect properly, and their safety is secured by intelligent supervision by men who are daily watching particular boilers. Signs of weakness are detected at times when the operations of an inspector would discover nothing wrong. This is a case where the Railroad Commissioners of New York will prove wise by leaving well enough alone. If they are zealous for something to do, we commend their attention to the condition of railroad grade crossings and signals.

Paper Wheels and Rails.

We have received a letter from a high officer of the Government of India, at Calcutta, inquiring about a report he had seen going the round of the papers, to the effect that certain railroads in this country were using paper rails. An item went the rounds of the papers here about a year ago intimating that paper rails were being manufactured, and many people got misled by the statement. The same paragraph appears now to be traversing the foreign journals. The great success of paper wheels led many people, who did not understand the conditions under which they are used, to believe that paper rails were practicable. The paper material of a wheel does not come in contact with the rail, nor does the service subject the soft material to abrasion. The paper merely fills the center of the wheel, and it is encircled by a heavy steel tire forced on very tight.

The method of making paper wheels builds up a structure stronger than iron alone, yet possessing a certain elasticity which greatly increases the factor of safety. The paper sheets are cut in circular shape, and pasted together till they form a disk, which is put into a press and subjected to a pressure of about 400 tons. Several of these disks, united by great pressure, constitute the body of the wheel. The block thus formed is turned down on a lathe till it is a little larger than the inside area of the tire. The material turns under the lathe tool like very hard wood, and in appearance it resembles dark oak, although its density is much greater. The plates which form the hub are then bolted to the block, and the tire forced on by a powerful hydraulic press. The wheel is then ready for the axle.

So far as we can learn, the report that paper rails were being manufactured was started by an editorial in a country paper, the writer of which evidently believed there was no iron used about a paper wheel. The matter was so novel and striking that it attracted attention, and some technical papers passed along the rumor when they ought to have investigated the matter.

An experiment was recently made in London with a new form of electric light for railroad trains, which seemed to give surprisingly good results. No motive power is required, the light being produced from a primary battery charged with chemicals. A battery with the light attachments was placed on a train on the Southwestern Railway, and in several trials gave good illumination with incandescent burners. The system is claimed to be cheap. Should this prove true, improvements may in course of time be effected in the lighting up of railroad trains a consummation devoutly to be wished for on many roads.

A committee of the Franklin Institute, Philadelphia, consisting of some of the most eminent engineers in that city, was some time ago appointed to investigate and report upon the advisability of requiring steam engineers to be licensed. A proposal had been made to pass a city ordinance requiring all engineers to be regularly examined and licensed before taking charge of engines or boilers. Last week the report of the committee was submitted and the majority were against a system of licenses. A minority re-

port was made, taking the opposite view of the matter. Coleman Sellers and Washington Jones belonged to the majority side, while J. W. Nystrom represented the minority.

Recently there have been some changes worth noting in the editorial chairs of some of our contemporaries. Thomas Pray, Jr., has retired from the editorial conduct of *Cotton, Wool and Iron*, of Boston, a change which will, no doubt, be regretted by the readers of that journal. Mr. Pray, during the four years and a half he was editor of *Cotton, Wool and Iron* (formerly *Journal of Commerce*), built it up to a circulation and influence it had never before approached. This was done mainly through his personal energy and perseverance. He has opened an office as consulting engineer in Boston, and will hereafter devote himself wholly to his profession. M. N. Forney retires as one of the editors of the *Railroad Gazette*, which is also a change to be regretted by the readers. Mr. Forney's extensive experience in railroad matters and acquaintance with the men conducting railroad operations, together with his journalistic skill, have placed him foremost among the editors of railway publications. He will retire, we understand, to obtain needed rest. Wm. E. Partridge, who was for more than ten years connected with the *Iron Age*, has become associate editor of the *National Car Builder*. In his new position Mr. Partridge will have an excellent field to apply his well-recognized ability in technical literature.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(12) W. C. T., Rome, N. Y., asks: Should the third or bottoming tap of a set be straight or slightly tapered back from the end? *A.*—Slightly tapered, the largest at the end.

(13) Apprentice, Paducah, Ky., asks: What will prevent steel wire from rusting? *A.*—Pure paraffine warmed, rubbed on and wiped off with a woolen rag, is good.

(14) A. G., Scranton, Pa., asks: Will you give me a rule for proportioning cone pulleys? *A.*—See AMERICAN MACHINIST of February 5, 1881; October 15 and 22, 1881; November 26, 1881; and February 25, 1882.

(15) C. S. J., Jamestown, N. Y., writes: In your column of questions and answers, G. A. H. inquires about tempering a drill for hard material. I thought you would advise him to use potash, but you did not. Do you not approve of its use? *A.*—We have never found it of any value with best tool steel.

(16) G. H. P., Lynn, Mass., asks: What dimensions of miter gears shall I use to transmit the power from a pair of 2½″x6″ cylinders, the gears being Bessemer steel or cast-iron? *A.*—We should suppose, without knowing more of the circumstances, that gears 7″ to 8″ diameter, ¾″ to ⅞″ pitch, if cast-iron and ⅝″ of steel, with face 2½ times the pitch, would answer.

(17) A. B., St. Mary's, Kan., asks: Can you tell me how to make a tool with which to choke-bore a gun barrel? *A.*—Make a square reamer about 2″ long, with the end beveled or tapered back the shape you want the barrel at the muzzle. The reamer should be made so that a rod to reach the length of the barrel can be attached. To force the reamer out to cut, use a hard wood wedge, with one flat and one rounded surface. Paper between the flat surface of the wedge and the reamer will enlarge the cut. We believe choke-boring is not resorted to at present, a die being used to contract the bore at the muzzle.

(18) J. A. B., Elkhart, Ind., asks: 1. What is the difference between a thermometer used on a vulcanizer and one used to indicate the temperature of the weather? *A.*—The thermometer used with the vulcanizer would naturally be graduated to indicate higher temperatures. 2. If a vulcanizer is filled two-thirds full of water, then closed and set over a gas furnace till the thermometer indicates 320 degrees, what will be the pressure of steam? *A.*—320 degrees temperature indicates a total pressure of 88 lbs., or, say, 73 lbs., by gauge. 3. Why is the glass bulb of the thermometer placed in a cavity filled with mercury? *A.*—In indicating temperatures under such circumstances, it is necessary to cover the bulb with something that will prevent its exposure to the air and equalize the temperature.

(19) G. C. H., Cleveland, Ohio, writes: In the shop where I work they build a chuck upon which a circle is struck and marked off in degrees. What I want to know is how to figure so that by gearing the lathe, holding the work in the chuck, revolving the gear on the screw one tooth will revolve the work one degree? *A.*—There are 360 degrees in a circle; hence the chuck must make a complete revolution by moving the screw gear (one tooth at a time, as you propose), 360 times. If you have a compound-geared lathe, you may have gearing to accomplish this. You must gear so that the spindle will revolve as much slower than your screw gear as is represented by 360 divided by the number of teeth in the screw gear. For instance, if you use a 60 wheel on screw, you must gear your spindle 360÷60=6 times slower. Then, by running one tooth at a time on the screw, you will revolve the screw six times and the spindle once.

(20) R. J., Scranton, Pa., asks: 1st. What towns in Texas are the best for machinists to go to? *A.*—There are not very many machine shops in Texas, and we cannot tell where the best inducements are offered. The most shops are in Galveston, Dallas, Houston, Austin, Sherman and Waco. 2d. What are the average wages of machinists in that State, and what would it cost to live there—I mean to board by the week? *A.*—This inquiry has been referred to the Fort Worth Machine and Boiler Works, who kindly answer as follows: "The wages of machinists are from $2 50 to $3 per day, and some railroads pay as high as $3.25. Blacksmiths are paid from $2.25 to $3.50 per day on railroad work. At present there is no demand for any kind of mechanics, except carpenters, who command from $2.25 to $3.25 per day. Board is rated from $4.50 to $6 per week. Moulders are getting from $3 to $4 per day. Living is quite reasonable, rent high, and other things in proportion."

(21) W. J. D., Stoneville, Mich., asks: 1. Is it possible for air to be in a tight boiler, with the pressure inside less than 14 7-10 lbs. per square inch? *A.*—Yes. Air may be at any pressure less than that named—one atmosphere. 2. Suppose I have a cylinder of any length, with the piston five inches from one end and air in that end. Is it possible to reduce the pressure in that end below 14 7-10 lbs. by drawing out the piston and increasing the space? *A.*—Yes. 3. I have charge of a boiler 4½ feet diameter and 21 feet long. What is the total pressure in the boiler, the gauge pressure being 75 lbs.? *A.*—You can easily calculate this for yourself, by adding together the square inches of surface in the shell and the exposed surfaces of the heads (that is, the area of heads less the combined area of tubes or flues), and multiply the sum by the pressure per square inch. This will give the total pressure in pounds. 4. If the water cylinder of a pump is 4″ diameter, what should be the diameter of steam cylinder to pump against a head of 500 feet, the steam pressure being 70 lbs.? *A.*—From 10″ to 12″, depending on the duty required.

BUSINESS SPECIALS

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

James W. See, Consulting Engineer, Hamilton, O.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass.

F. VanWinkle, Mech. Engin'r, 22 Cortlandt St., N. Y.

Metal & Wood Patterns—G. D. Lambert, N. Haven, Ct.

Patterns & Models, G. D. Lambert, New Haven, Ct.

Presses & Dies, Ferracute Mach. Co., Bridgeton, N.J.

"Tack Machinery"
Willets Manufacturing Co., Providence, R. I.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York

Foot Power Machinery, for workshop use, sent on trial if desired. W.F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Patents.—Franck D. Johns, Att'y at Law & Solicitor of Patents, 617 Seventh St., Washington, D. C.

Pattern and Brand Letters. Vanderburgh Wells, & Co., corner Fulton and Dutch streets, New York.

Consulting Engineer and Mechanical expert, C. C. Hill, 144 LaSalle street, Chicago, Ill.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

For sale, lathes of best designs from new patterns. George A. Ohl & Co., E. Newark, N. J.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 626 E st., Washington, D. C.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Slide Valve Working Models. Send for circular. See notice in this paper, October 13, page 9. E. E. Roberts, 107 Liberty Street, N. Y.

Jack pump and ladder chain machines, 40 to 80 links per minute, direct from coil. The Gaylord, Cross & Speirs Company, Waterbury, Conn.

The "Wax Process" engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

New Books, relating to steam, the steam engine, mechanics, machinery, and engineering. Send for catalogue. Fred. Keppy, publisher, Bridgeport, Conn.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large: prices low. Frasse & Co., 62 Chatham St., N. Y.

H. O. Reinhardt, M. E., Mem. Am. Soc. Mining Eng., Chihuahua, Mex., invites correspondence of man'f'rs of machinery desiring to introduce same in Mexico.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

"Recent Locomotives."
Specifications and large-scale engravings, with details, of 70 present types of locomotives, $5. For sale by the Railroad Gazette, 73 Broadway, New York.

BOUND VOLUMES of the AMERICAN MACHINIST for 1880. A limited number for sale at $3.50 per volume, express charges to be paid by purchaser. $4.50 per volume will be charged for 1881 and 1882. AMERICAN MACH. Pub. Co., 96 Fulton st., New York.

"HOW TO KEEP BOILERS CLEAN."—A book of seventy-two pages, telling how to prevent scaling, foaming, priming, and burning, with other valuable information, will be sent to any address FREE of postage, by James F. Hotchkiss, 86 John street, New York.

Any of our readers who have complete files of Volumes I. and II. in good condition, bound or unbound, can probably find a purchaser by addressing us, and stating the lowest price they will accept. AMERICAN MACHINIST PUBLISHING COMPANY, 96 Fulton street, New York.

EXTRACTS FROM CHORDAL'S LETTERS, containing nearly 400 pages, 12mo, handsomely bound in cloth. New and enlarged edition, with additional illustrations, many of them humorous and all effective—over 50 in all. Just the thing for a holiday or birthday gift. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

Patent "Common Sense" Binder for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address, in the United States, by mail for one dollar. To Canada and foreign countries 75c., the purchaser to pay custom-house duties and express charges. American Machinist Publishing Co., 96 Fulton street, New York.

Since October 4 *The Sanitary Engineer* has been published every Thursday in London, the date of issue there being two weeks later than the date in New York. The American issue complete, advertising pages as well as reading matter, is sent over each week in sheets. These are folded and bound in London, with an attractive colored cover, on which appear advertisements intended for the British and Continental readers of the paper. The publishers guarantee for the next year a larger English circulation, among the same classes as read it in the United States, than is now enjoyed by any English publication of a similar character. These include architects, clubs, chemists, civil and sanitary and mechanical engineers, gas and water companies, builders, contractors, manufacturers of food products, pharmacists, electricians and manufacturers of electric lighting apparatus, etc., health officers, physicians, plumbers, manufacturers and dealers in water, gas, steam and plumbers' supplies, officers of public institutions, managers of large corporations, libraries, reading-rooms, and intelligent householders generally.

The Sanitary Engineer, conducted by Henry C. Meyer, is published every Thursday at 140 William Street, New York, and 92 and 93 Fleet Street, London.

Subscription, U. S. and Canada, $4 per year, postpaid. Foreign, $5. Single copies, ten cents, from all newsdealers. Specimen copies free, if this advertisement is referred to.

MANUFACTURES.

Dalton, Ga., is to have a $100,000 cotton factory.

The Newark (N. J.) Lime and Cement Company are putting in a 60 horse-power boiler.

Ottumwa, Ia., is to have a cutlery works. The main building is to be 100x50 feet, and a wing 50x36 feet.

The Coles Chemical Works, Newark, N. J., have erected new works, and have put in engines, boilers and machinery.

Henry A. Dingee, of New York City, will build a six-story factory, 50x195 feet, on Cherry Street, near Corlears Street.

Hall & Sons, 522 East 20th Street, New York, are enlarging their planing mill, and are putting in a new tubular boiler.

John Clarke, 675 Willoughby Avenue, Brooklyn, N. Y., will erect a three-story factory, 40x60 feet, on Stockton Street.

Lorillard Spencer, 3 Mercer Street, New York, will build a five-story factory, 24x95 feet, at 63 South Fifth Avenue.

A stock company for the establishment of a cotton mill has been organized in Shreveport, La., with a capital stock of $150,000.

The Toledo (O.) Car Wheel Foundry's force has been increased, and the Maumee Rolling Mills, Toledo, will soon begin operations.

There is some talk of removing the shops of the Peninsula Car Company from Adrian, Mich, to some other locality. They employ three hundred to five hundred men.

The Sheffield Land, Iron and Manufacturing Company was organized at Tuscumbia, Ala., a few days ago. It has a capital stock of $500,000, all subscribed.

Northern capitalists purpose establishing a woolen factory at Waco, Texas. The capital to be invested is $100,000, and the mill will employ 100 operatives to begin with.

The iron foundry buildings on Centre Street, Brockton, Mass, have been leased to Hinman, Frank Dow and Fred. Stevens, all of Boston, who will engage in the foundry business.

The repair shops of the Indiana, Illinois and Iowa Railroad Company have been located at Kankakee, Ill., on land donated by the citizens. Work on the buildings will be commenced at once.

The machine shop and storehouse of the Boston and Providence Railroad in Boston, which were burned down lately, are to be rebuilt at once.

The Iron River Furnace Company has started to build a blast furnace at Iron River, Wis. John S. McDonald, of Fond du Lac, is president, and John T. Jones, of Iron River, general manager.

The Cleveland Rolling Mill Company, at Cleveland, has taken a contract for 120 tons of 50-pound steel rails for the Cincinnati and Eastern road. This company has orders enough on hand to keep its rolling mills at work for several months.

It is reported that New York capitalists are planning to erect an immense rolling mill in Lowell, Mass., near the intersection of the Framingham and Lowell Railroad and the connecting branch of the Lowell and Andover. Some 1,500 hands will be employed.

The Deane Steam Pump Co., Holyoke, Mass., has just shipped a low-pressure pump having a capacity of 3,000 gallons per minute. It was built for a party in N.Y. State, and is to be used for irrigating purposes. The discharge pipe required is 18 inches in diameter.

The Terry Clock Company, of Pittsfield, Mass., have declared a dividend of 25 per cent. They are constantly enlarging and extending their business. Their clocks are not only being sold in all parts of this country, but they are recently having orders from Europe.

The American Automatic Cartridge Company has been formed in Lowell, Mass., to manufacture under the patents of J. H. King and J. A. Bagley. Among the citizens in the enterprise are C. Callihan, J. H. Pindar, John Cummings, Francis Jewell, J. A. Morrison and Dr. B. F. Heald.

The Marshall Car Wheel and Foundry Company, in Marshall, Texas, has begun to use its new foundry, which has a capacity of 100 car wheels a day. The iron used for wheels is charcoal iron made at the company's furnace about seven miles from Jefferson, Tex., from local ores.

The Chase Turbine Manufacturing Company, Orange, Mass., are partially occupying their new brick shop on the site of one burned a year ago. They are doing more business than ever before on their old specialties—Chase wheels and circular saw-mills—and are making preparations to bring out a number of new machines in the saw-mill line.

Wednesday morning, December 12, the factory of H. B. Brown & Co., manufacturers of the Merriman bolt cutter, at East Hampton, Conn., was entirely destroyed by fire. Loss, $20,000 to $30,000, partially insured. They will start up temporarily in some one of the near cities, and in the spring rebuild or settle in some other locality. They have been very busy during the fall, and had a number of large orders on their books at the time of the fire.

The Lancaster (Pa.) Watch Factory is running along nicely, full handed, and is meeting a brisk demand (by the trade) for their watches, which are giving excellent satisfaction. They have just completed and placed on the market a 24-hour movement, anticipating some demand for the same. The dial is figured from 1 to 24, and consequently the hour hand makes but one revolution in a day. The company expect to see the 24-hour system adopted in the near future.

The firm of Osgood & MacNaughton, of Albany, N. Y., has been merged into a joint-stock Company—the Osgood Dredge Company. The new company will continue the business of designing, constructing and operating the Osgood boom dredges, and all kinds of steam excavators, ditching and hoisting machines and derricks. Their circular says: "Mr. Osgood has returned from an eight-months' visit to Europe with greatly improved health, during which time he has devoted much study to the building and working of the best foreign dredges and excavators, and will give the benefit of his experience to all customers." The officers of the new company are, Ralph R. Osgood, President; James MacNaughton, Vice-President; John K. Howe, Secretary and Treasurer.

The Portland (Me.) Rolling Mills, says the Boston *Commercial Bulletin*, damaged by fire some time since, have been repaired and work renewed, except in the puddling mill The main building has been extended from its former length 52 feet, and otherwise improved very much for convenience in their manufacturing. At present 225 men are employed, and that number will be materially increased when the new machinery, which has just arrived, is placed in position, for the manufacture of horse shoes—an industry which is entirely new to Maine. This machine turns out shoes at the rate of from twenty to forty per minute, according to the speed of the machine, and so perfect in its mechanism that they are practically ready for use as soon as they leave the machine.

The National Pipe Bending Company, New Haven, Conn., have recently sold a 600 horse-power feed-water heater to the N. H. Wire Company; one of 300 horse-power to the Stanley & Willard Manufacturing Company; one of 500 horse-power to a concern in Richmond, Va.; one of 150 horse-power to Lewiston (Me.) Electric Light Company; one of 150 horse-power to the Fall River Electric Light Company; one of 200 horse-power to Odell Manufacturing Company; one of 100 horse-power to W. G. & A. P. Morrison Company; one of 150 horse-power to Metropolitan Gas-Light Company; and one of 80 horse-power to the Reading Hardware Company. They are also doing a good business in making iron coils and car radiator bends.

Machinists' Supplies and Iron.

NEW YORK, December 27, 1883.

In machinists and engineers' supplies, while business is not lively, there is nothing of the character of stagnation about it.

In American pig iron the conditions remain unchanged, with prices just steady. We quote: No. 1 X Foundry, $20 to $21.50; No. 2 X, $18.50 to $19.50, these being asking prices at tide water.

But a small quantity of Scotch pig is arriving, and that mostly on direct orders. We quote prices for lots in store: Coltness, $22.50 to $23; Glengarnock, $21.50; Gartsherrie, $23; Summerlee, $22.50; Eglinton, $20.50.

Antimony in small lots. Hallett's brand, 10⅛c. to 10¼c; Cookson's, 11⅛c. to 11¼c.

Copper—Lake, 14⅞c. to 15c.; other brands, 14⅜c. to 15c., the demand and supply being about equal.

Lead in jobbing lots, 3.65c. to 3.70c.

Spelter is in light demand, refined selling at 8c. to 8¼c.

Tin is held steadily, at 20½c. for Banca; Straits and Malacca, 18½c. to 18⅝c.

✲WANTED✲

"Situation and Help" Advertisements, 30 cents for each seven words (one line) each insertion. Copy should be sent to reach us not later than Thursday morning for the ensuing week's issue.

Experienced mechanical draughtsman desires engagement. Address, J. H., care AM. MACHINIST.

Wanted—A moulder to take charge of a small foundry. Address, Lively, Newnan, Ga.

Wanted—A foreman machinist; one competent to design, construct and erect machinery. None but those thoroughly capable need apply. Address, P. O. Box 1358, New York City.

Wanted—A first-class energetic salesman to introduce a new automatic engine manufactured by a well-known concern. Must be a thorough engineer, and give first-class references. Address, B, BOX 10, AMERICAN MACHINIST.

A first-class tool and model maker desires a situation. Am capable of constructing and designing tools, fixtures, fine machinery, etc. Experienced in management of men. Address Box 2, care AM. MACHINIST.

Wanted—A situation by a blacksmith as foreman, or a place at the fire on tool-dressing, tempering, die forging, etc.; first-class workman on steel; a reliable man; will go to any part of the country. Correspondence solicited. Address, F. R. A., Box 730, Holyoke, Mass.

Draughtsman—A student, who is thoroughly familiar with Bartlett's "Analytical Mechanics," Rankin's Machinery and Mill Work," Church's "Descriptive Geometry," etc., etc., would like a position where he can gain the requisite experience. Address, C. H. Lindenberger, Defiance, Ohio.

A practical man, experienced in the management of a machine shop, wants a situation. Competent to design, estimate costs, and superintend the whole business of the ordinary foundry and machine works, from taking the order to making out the bill. Steam engines or general jobbing much preferred. Expectations not less than $1,200 a year. Would put skill against capital. Correspondence solicited. Address, F. J. Masten, Box 392, Pullman, Ills.

SHEPARD'S CELEBRATED $60 Screw Cutting Foot Lathe.

Foot and Power Lathes, Drill Presses, Scrolls, Saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers. Send for catalogue of outfits for amateurs or artisans. Address,

H. L. SHEPARD & CO.,
341 & 343 WEST FRONT STREET,
CINCINNATI, OHIO.

The Hoffman Lubricator.

For Stationary and Locomotive Engines. The simplest Cup made. No water column to freeze. Lock the feed and it runs itself. Address,

O. A. JENKS & CO.,
BINGHAMTON, BROOME CO.,
P. O. Box 287. NEW YORK

WORKSHOP RECEIPTS.

For the use of Manufacturers, Mechanics and Scientific Amateurs. First and Second Series, each containing about 450 pages, with illustrations. **PRICE $2.00** per volume. Descriptive circular and catalogue of books for mechanical engineers sent free.

E. & F. N. SPON, 35 Murray St., N. Y.

HILL, CLARKE & CO.

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Boston, Mass.
BRANCH OFFICE, 800 N. 2nd STREET,
St. Louis Mo.

Have just issued new

CATALOGUE
—OF—
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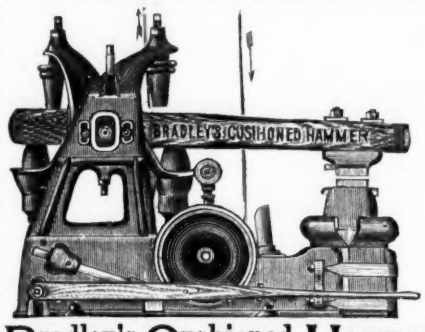

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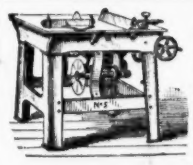

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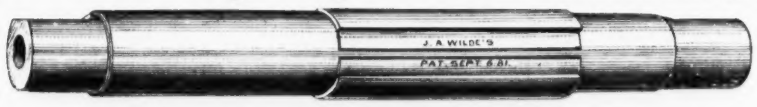

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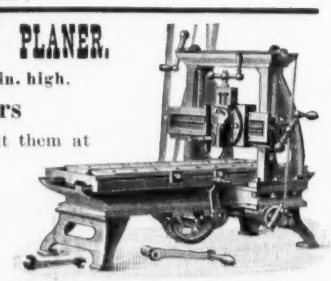

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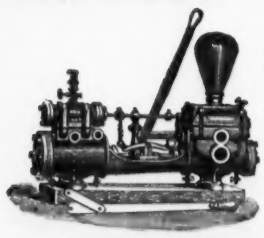

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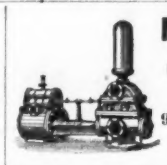

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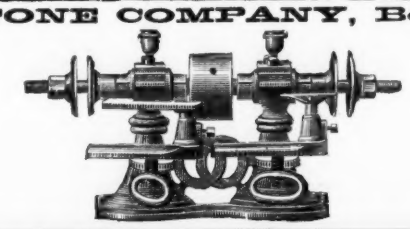

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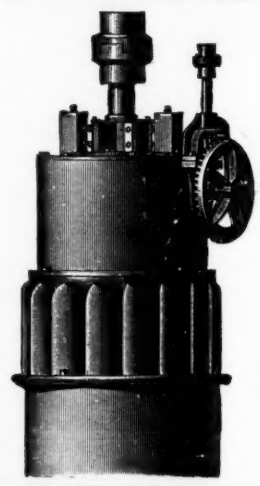

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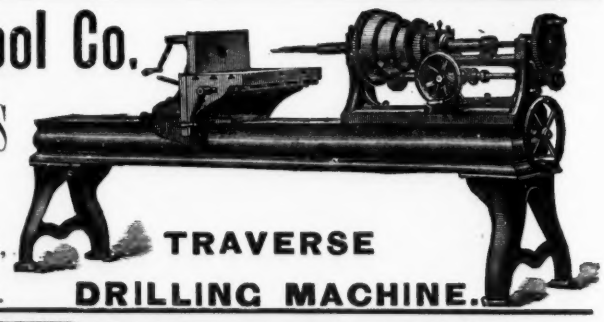

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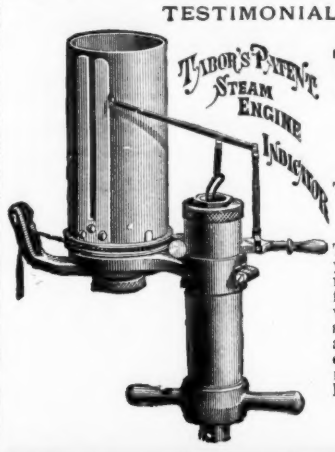

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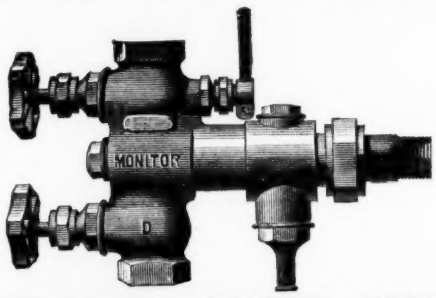

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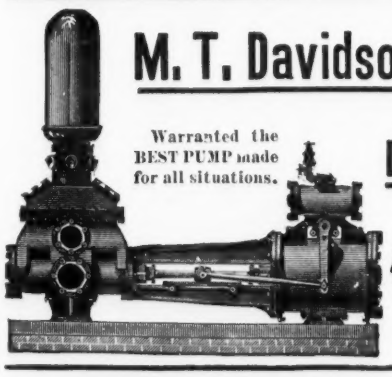

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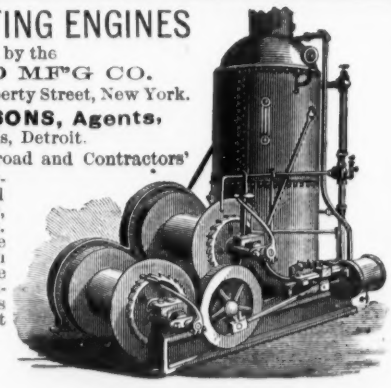

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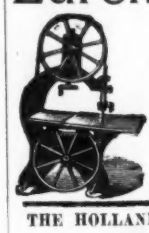

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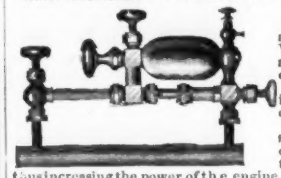

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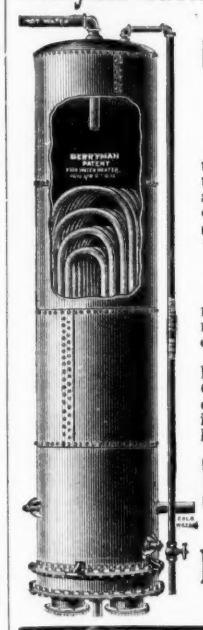

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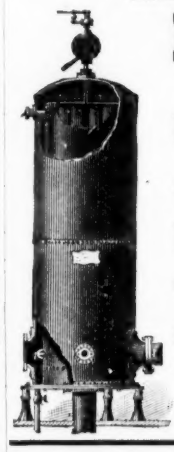

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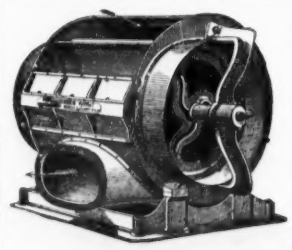

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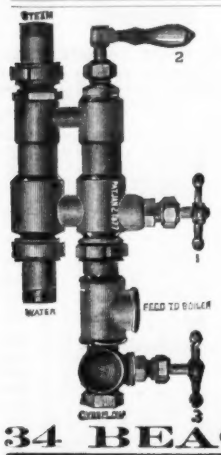

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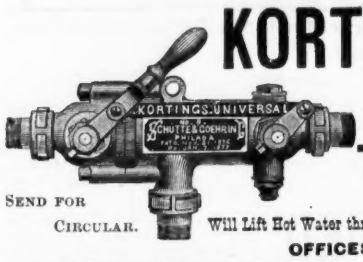

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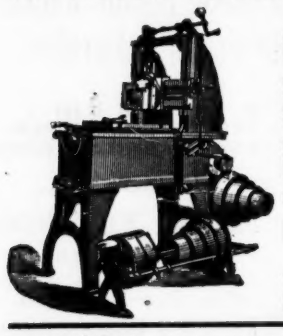

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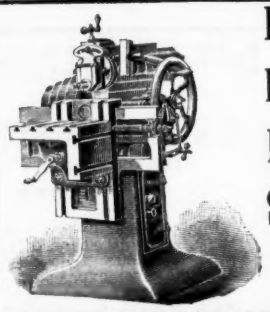

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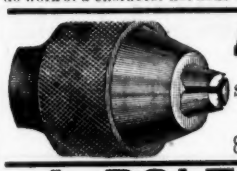

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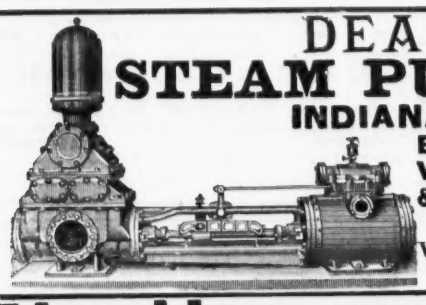

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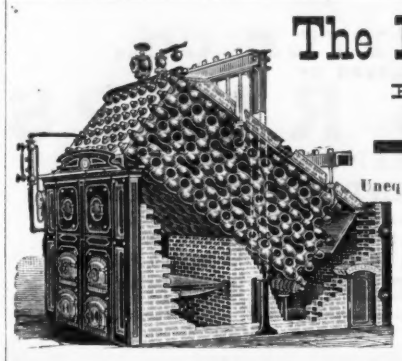

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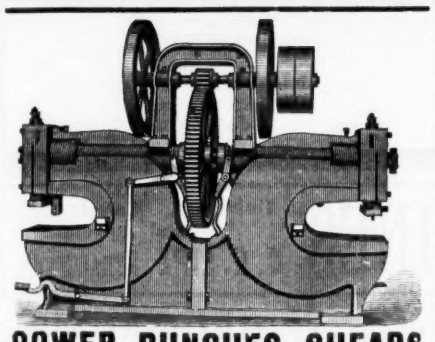

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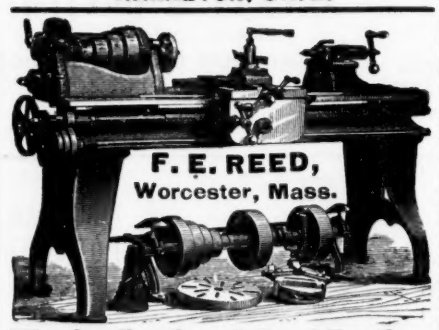

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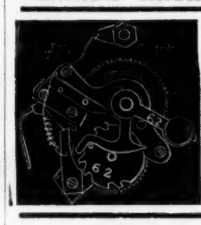

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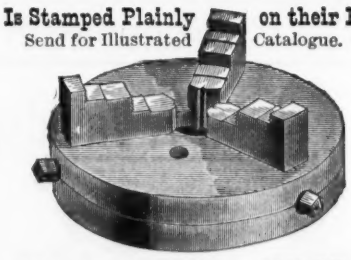

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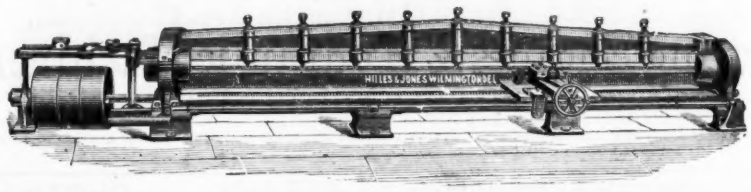

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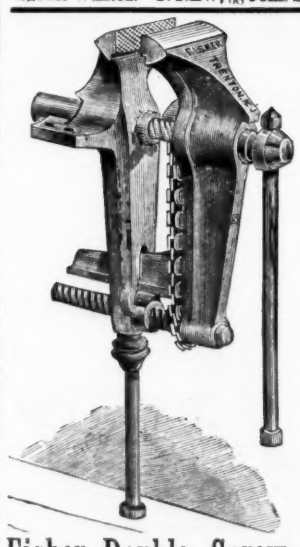

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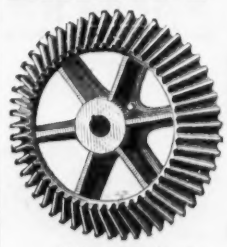

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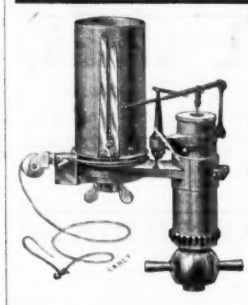

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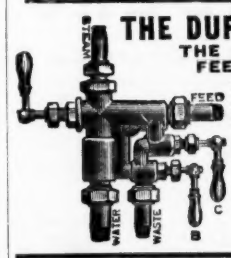

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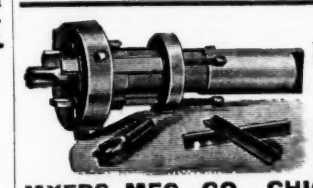

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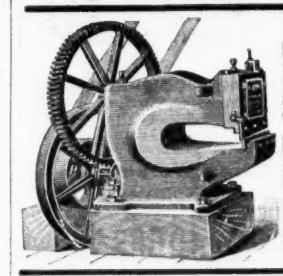

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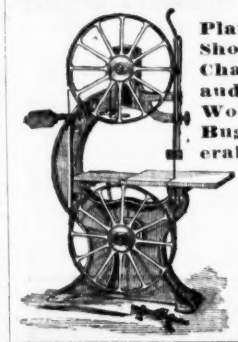

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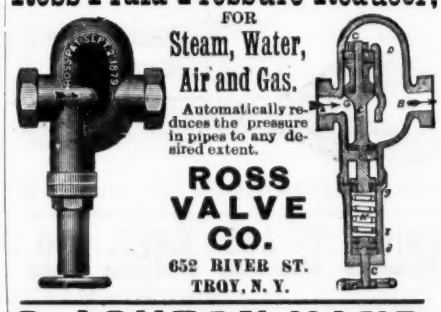

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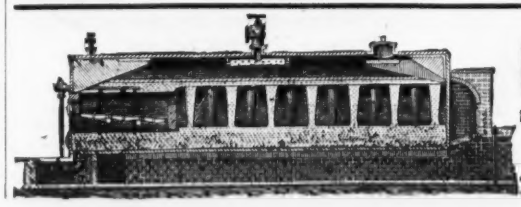

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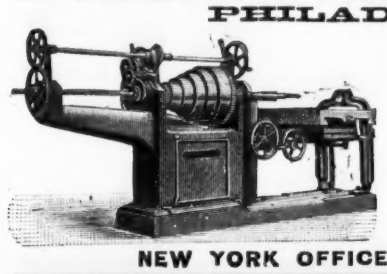

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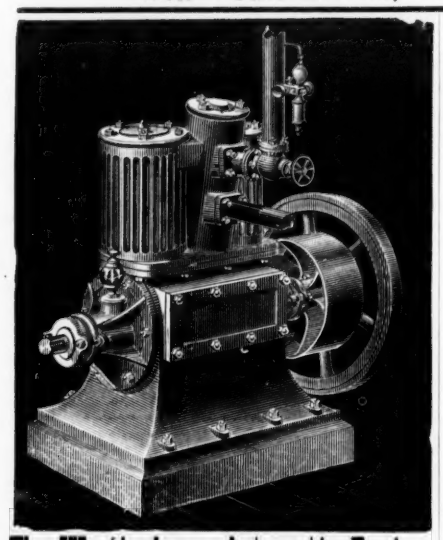

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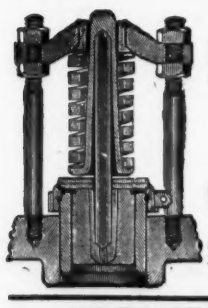

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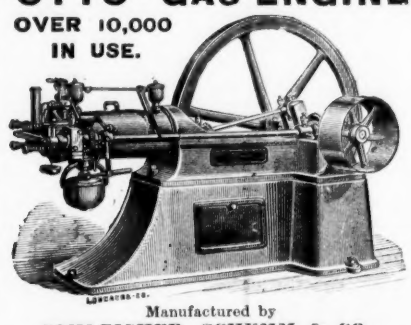

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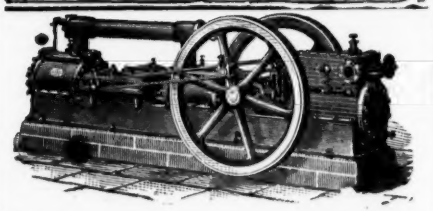

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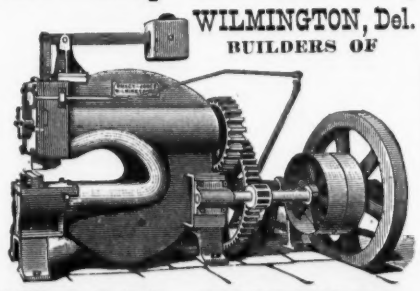

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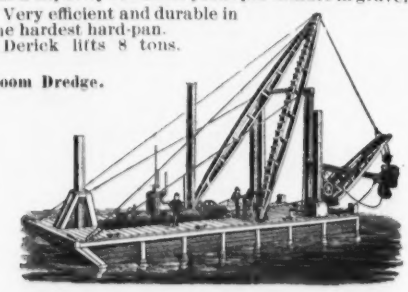

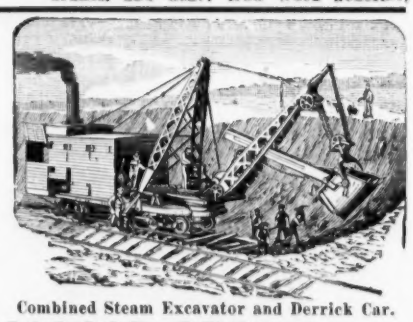

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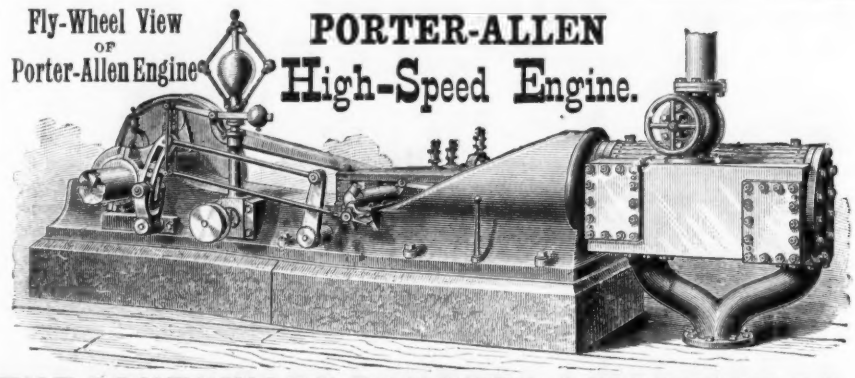

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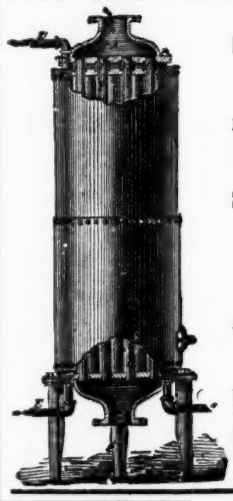

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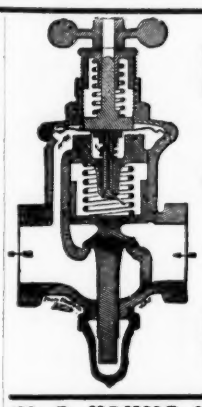

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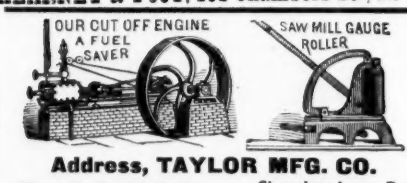

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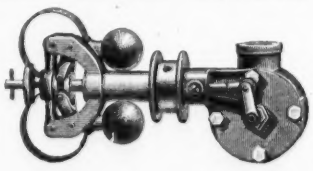

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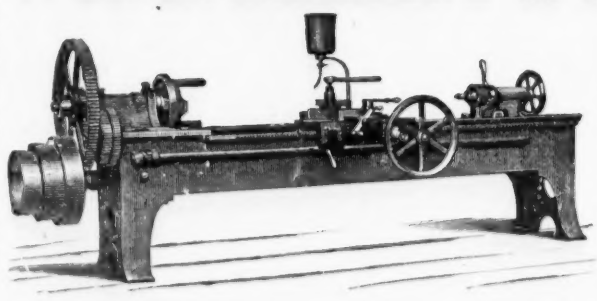

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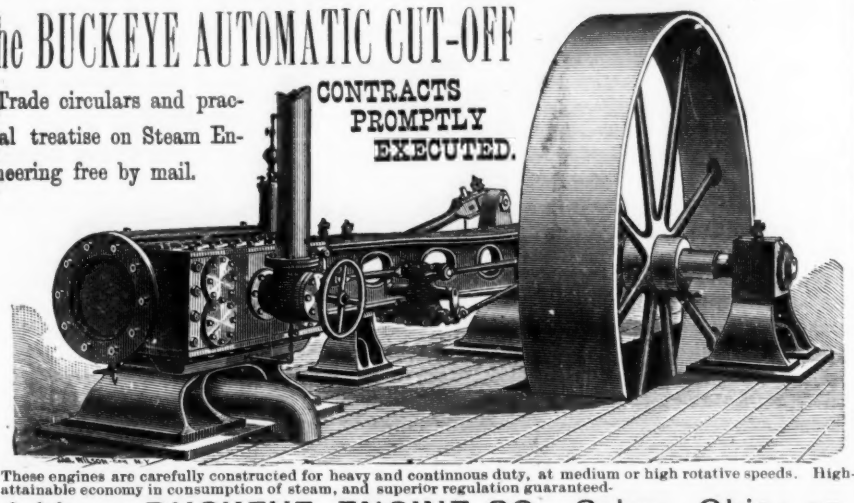

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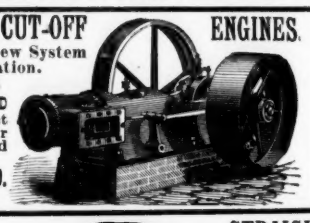

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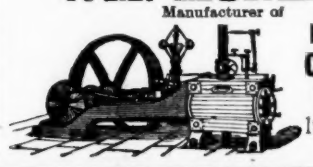

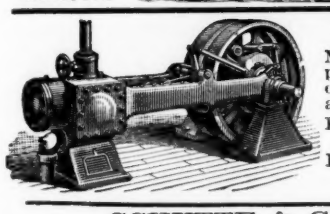

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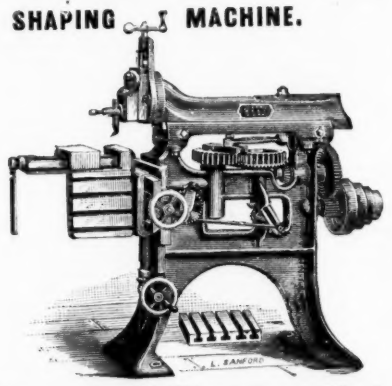

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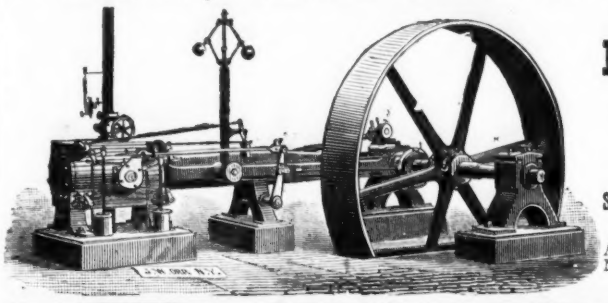

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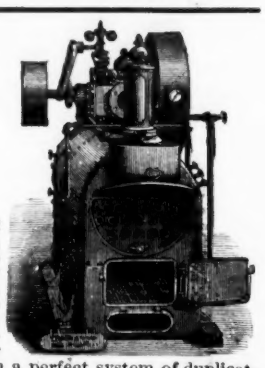

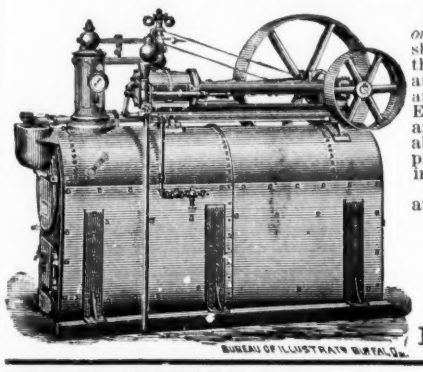

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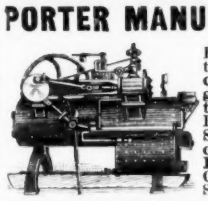

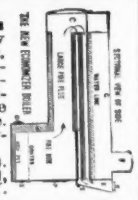

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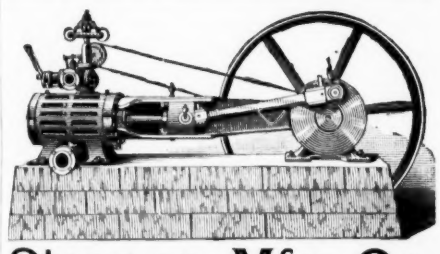

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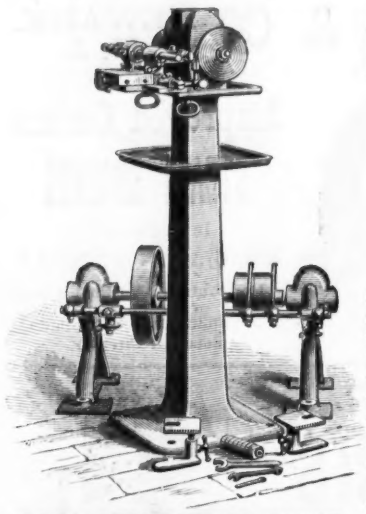

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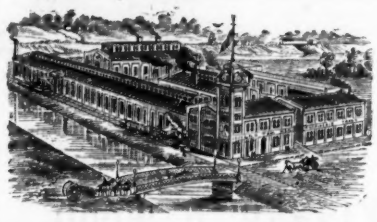

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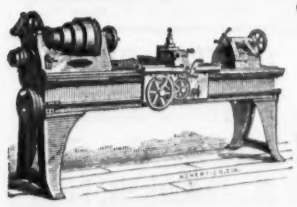

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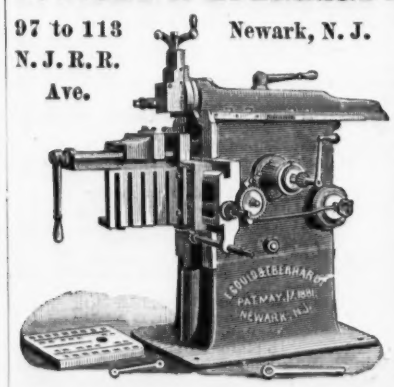

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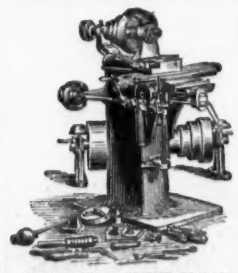

Milling Machines,
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Tapping Machines,
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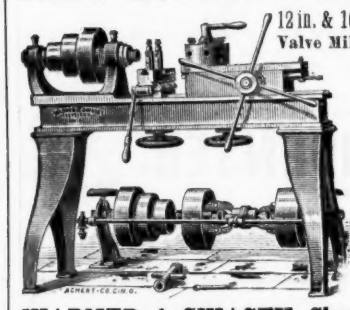

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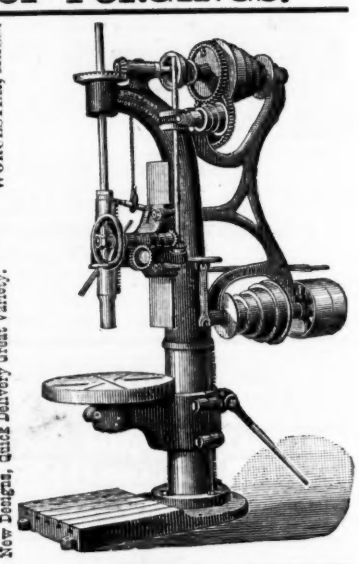

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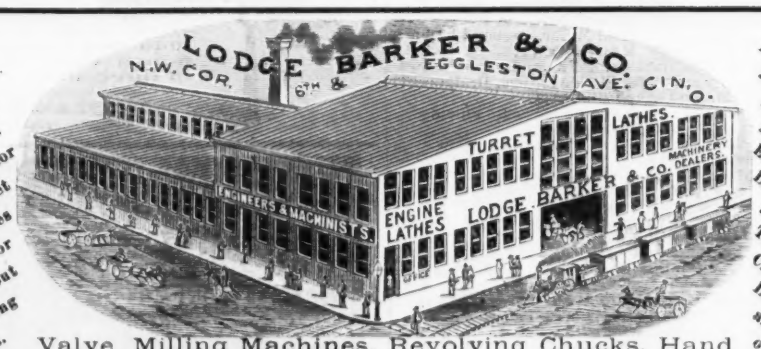

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